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Electric Load Forecast

1989/90 — 2009/10

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SUMMARY

PROBABLE ECONOMIC FORECAST

The Economy

The B.C. economy (Gross Domestic Product or GDP) is forecast to average 2.8% real annual growth over the period 1989 to 1999 and 2.3% in the following 10-year period to 2009. The main growth sectors through 1999 in the industrial area are projected to be paper and allied products manufacturing and non-resource based manufacturing. In the commercial area, trade and services are expected to be the highest growth sectors. Growth of the commercial area is projected to be higher than the industrial area throughout the 20 years.

Overall economic growth is forecast to average 2.6% through 2009 compared to 2.9% in last year's forecast.

Population Growth

Population growth in the 1.6% range on an annual basis is projected through 1999 and 1.3% in the following 10-year period through 2009. In-migration, particularly inter-provincial, is the critical variable of the forecast as the natural increase is relatively constant.

Population growth is projected to average 1.5% through 2009 compared to 1.4% in last year's forecast.

Energy Prices

Electricity prices are assumed to decline in real terms by 1.5% per year for the first 10 years and remain flat in real terms (i.e. increase at the rate of inflation) thereafter. The result by the late 1990's is a real price decline of approximately 14%. Natural gas and light fuel oil prices are expected to increase marginally in real terms. However, natural gas is projected to maintain its competitive advantage over electricity throughout the 20-year period.

This energy price forecast is essentially the same as assumed in last year's forecast.

Table 1 summarizes the major economic assumptions and provides a comparison to last year's (1988) forecast.

Table 1
COMPARISON OF 1989 AND 1988 PROBABLE ECONOMIC FORECASTS

Economic Assumptions	Forecast Prepared 1989	1988
B.C. Gross Domestic Product (GDP) Growth Rate (%/year)		
1988 to 1999	2.8	3.0
1999 to 2009	2.3	2.7
Population Growth Rate (%/year)		
1988 to 1999	1.6	1.4
1999 to 2009	1.3	1.4

PROBABLE ENERGY FORECAST

Total Energy Requirements

Electric energy requirements (sales plus system losses) are projected to increase from 42,612 GW.h in 1988/89 to 58,920 GW.h in 1999/00 and 73,920 GW.h in 2009/10 for an annual average growth rate of 2.7%. This represents an expansion of the present system by 38% by 1999/2000 and 73% by 2009/10.

Total Sales

Sales are projected to increase by 14,500 GW.h to 1999/00. The components of the projected increase are: residential provides 2,900 GW.h, commercial 4,200 GW.h, industrial 7,000 GW.h and other miscellaneous 400 GW.h.

Residential Sales

Residential sales are projected to be the slowest growth sector. Continuing efficiency improvements in appliances will limit growth. Also, the natural gas pipeline to Vancouver Island will slow the growth of electric heating load.

Commercial Sales

Commercial sales are projected to grow faster than both residential and industrial sales. The high (economic) growth rates forecast for the trade and services sectors are the main factor.

Industrial Sales

The paper and allied products sector is projected to grow by 4,850 GW.h by 1999/00. This electric intensive (mechanical pulping) load is thus expected to account for nearly 70% of additional sales in the industrial area and 33% of total additional sales. Sales to the metal mining sector are projected to decrease by 600 GW.h with closures of existing copper mines more than offsetting new mine development.

Table 2 provides the sales forecast for key years by the main sectors. Losses are shown and a breakdown of total requirements (sales plus losses) to the integrated and non-integrated systems is shown. Figure 1 is a graph of the total gross requirements, historical and projected.

Table 2
B.C. HYDRO PROBABLE GROSS LOAD REQUIREMENTS BY MAJOR SECTORS - SUMMARY
(Including SCL and WKP&L)

	Residential (GW.h)	Commercial (GW.h)	Industrial (GW.h)	Other (1) (GW.h)	Total Sales (GW.h)	Losses/ Accruals (GW.h)	Non-Integr. (GW.h)	INTEGR. SYSTEM TOTAL GROSS REQ'TS (GW.h)	INTEGR. SYSTEM PEAK (MW)
Actual									
1988/89	10700	9569	16713	733	37715	4897	176	42436	7765
Forecast									
1994/95	12373	11894	20865	992	46124	5923	187	51860	9080
Avg. Ann.% incr. 6 years:									
88/89-94/95	2.5%	3.7%	3.8%	5.2%	3.4%	3.2%	1.0%	3.4%	2.6%
1999/00	13588	13801	23691	1132	52212	6709	207	58710	10310
Avg. Ann.% incr. 5 years:									
94/95-99/00	1.9%	3.0%	2.6%	2.7%	2.5%	2.5%	2.1%	2.5%	2.6%
11 years:									
88/89-99/00	2.2%	3.4%	3.2%	4.0%	3.0%	2.9%	1.5%	3.0%	2.6%
2009/10	16231	17924	29738	1623	65516	8407	252	73670	12940
Avg. Ann.% incr. 10 years:									
99/00-09/10	1.8%	2.6%	2.3%	3.7%	2.3%	2.3%	2.0%	2.3%	2.3%
21 years:									
88/89-09/10	2.0%	3.0%	2.8%	3.9%	2.7%	2.6%	1.7%	2.7%	2.5%

Notes: 1. Inter-Utility transfers (including West Kootenay Power & Light) and firm export (including Seattle City Light).
2. Interruptible Marketing (E+) and Demand Side Management (Power Smart) programs are not included.

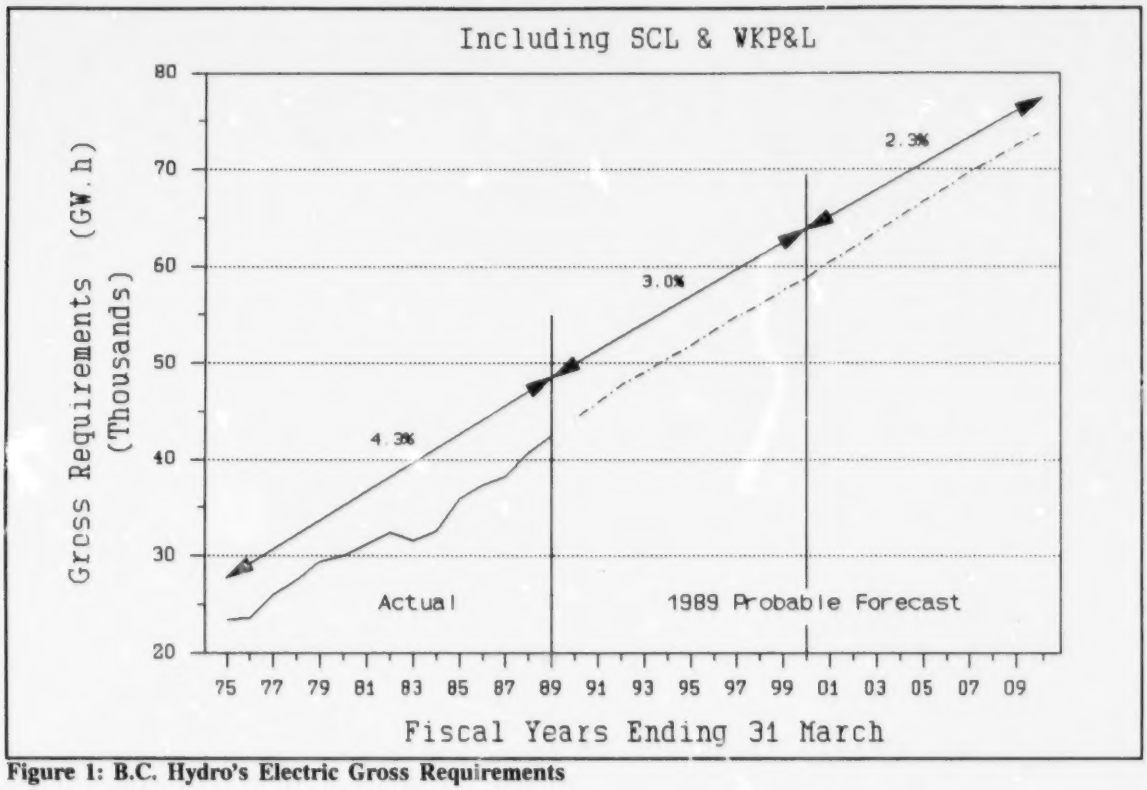


Figure 1: B.C. Hydro's Electric Gross Requirements

Compared to last year's forecast, the significant changes by 1999/2000 are:

- higher sales to the residential sector of 730 GWh. Actual sales for 1988/89 were considerably over forecast due largely to a higher than projected usage rate (kWh per customer). A higher usage rate has been used in the 1989 forecast with resulting higher sales.

- higher sales to the metal mining sector of 600 GWh. Continuing high copper prices have resulted in some of the existing mines making investment decisions to extend operating life by developing new ore deposits or utilizing lower grade ore. Increased exploration activity is now leading to proposals (and projected development) for some new mines.

- higher sales to the paper and allied products sector of 1,200 GWh. This reflects the additional proposals for new mills as well as a more positive outlook through the 10-year period.

- lower sales to WKP&L of 400 GWh. This results from lower projected growth by WKP&L and their intentions to purchase some energy from other sources.

Table 3 provides a comparison to last year's forecast.

Table 3
COMPARISON OF 1989 AND 1988 PROBABLE ENERGY FORECASTS

Probable Electric Forecast	Forecast Prepared 1989	Forecast Prepared 1988
1988/89 Actual Gross Requirements (GWh)	42,612	42,612
1993/94 Gross Requirements (GWh)	50,700	48,420
Average Annual Growth Rate (%/year) 1988/89 to 1993/94	3.5	2.6
1999/2000 Gross Requirements (GWh)	58,920	56,980
Average Annual Growth Rate (%/year) 1993/94 to 1999/2000	2.5	2.8
2009/10 Gross Requirements (GWh)	73,920	73,850
Average Annual Growth Rate (%/year) 1999/2000 to 2009/10	2.3	2.6
Forecast Advancement Compared to the 1988 Forecast (in years)		
- by 1993/94	1.75	-
- by 1999/2000	1	-
- by 2009/10	nil	-

RANGE OF ENERGY FORECASTS

To address the uncertainty in the probable electric energy forecasts, a range of forecasts has been projected around the probable load forecast for the integrated system.

By combining variabilities in the future levels of forecast drivers such as economic conditions and energy intensity, a probability distribution quantifying uncertainty in the gross load forecast was developed. The resulting distribution is illustrated by means of percentiles as shown in Table 4 and graphed in Figure 2. The percentiles may be looked at as confidence bands i.e. by 2009/10 it is projected that:

(i) There is a 5% chance that load requirements will be below 51,820 GW.h.
(ii) There is a 5% chance that load requirements will be above 100,610 GW.h.
(iii) There is a 90% chance that the growth rate will be between 1.0% and 4.2%

Gross requirements for the various forecasts for the integrated system (including SCL and WKP&L) are shown in Table 4:

Table 4
RANGE OF FORECASTS - INTEGRATED SYSTEM

	5th Percentile	25th Percentile	Probable	75th Percentile	95th Percentile
Gross Requirements (GW.h)					
1999/00	46,860	53,650	58,710	64,080	69,660
2009/10	51,820	64,000	73,870	86,590	100,610
Average Annual Growth (%/Year)					
1988/89 to 1999/00	0.9	2.2	3.0	3.8	4.6
1999/00 to 2009/10	1.0	1.8	2.3	3.1	3.7
1988/89 to 2009/10	1.0	2.0	2.7	3.5	4.2

Figure 2 is a graph of the forecasts.

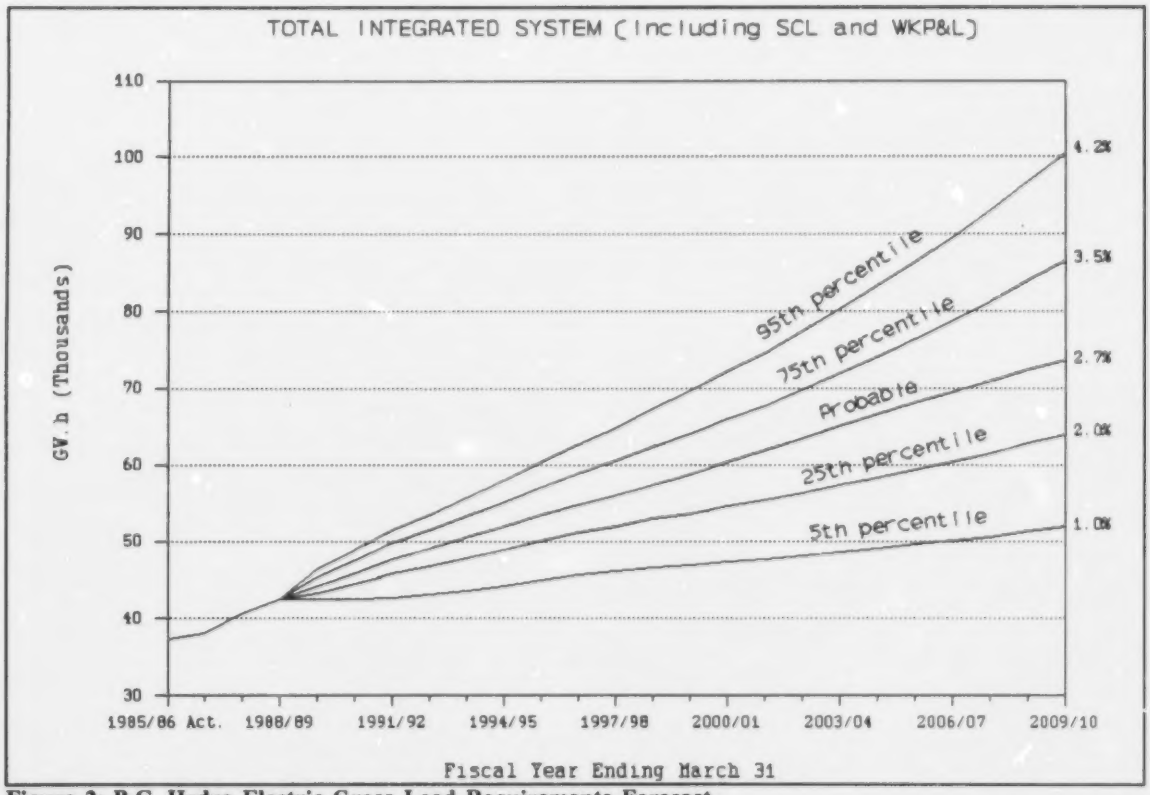


Figure 2: B.C. Hydro Electric Gross Load Requirements Forecast

SECTION 1 - INTRODUCTION

1.1 STRUCTURE OF DOCUMENT

This document presents details on B.C.Hydro's 1989 forecast of gross electric requirements through 2009/10 and is organized as follows :

Section 2 provides the **lifestyle, economic, population and energy price assumptions** that drive the electric forecasts.

Section 3 describes how the **probable (most likely) electric forecast** is built up from sales projections of the key sectors, i.e. residential, commercial, industrial and other. Consideration of the Interruptible Marketing (E+) and Demand Side Management (Power Smart) programs is excluded in the forecast development. The projections are done in detail for the first 10 years (through 1999/2000) with year-over-year forecasts for the various categories and major customers. This allows for financial planning and detailed distribution and transmission planning to be carried out. The second 10 years is based on economic trend projections and is mainly used for resource planning which does not require the same level of detail.

Section 4 deals with the inherent **uncertainty** in load growth which is a random variable with an expected value (the mean) and a standard deviation. It is necessary in planning to pay at least as much attention to the uncertainty in the forecast as it is to the probable outcome itself. A range of forecasts has thus been prepared around the probable forecast.

Section 5 discusses the present status and effect of **Marketing and Demand Side Management (called Power Smart)**, programs on actual load growth and load shape in the B.C. Hydro system. The Interruptible Marketing and Power Smart programs, while not factored directly into the 1989 forecasts, must be considered in system planning (resource, transmission and distribution).

Appendix A provides details on the forecast **process** and **methodology**.

Appendix B describes the method used to disaggregate the probable forecast by **rate categories**. It is required for revenue calculations and distribution planning.

1.2 ECONOMIC GROWTH FOR 1988

In 1988, the B.C. economy exhibited a strong growth of an estimated 4.4% in real terms in the provincial GDP (Gross Domestic Product). A healthy North American and International business environment created a demand for B.C.'s exports contributing to higher export growth and a large increase in capital investment.

Employment increased 4.0%, representing 52,000 additional jobs. Personal income grew 7.6% due to increased employment and higher interest earnings.

Population increased by 60,000 in 1988. Interprovincial in-migration accounted for nearly 30,000 of the increase and 16,500 was from international in-migration.

The significant increase in population was reflected in housing starts which reached 30,487; the highest level since 1981.

1.3 LOAD GROWTH ON B.C. HYDRO DOMESTIC SYSTEM

Load growth on the B.C. Hydro domestic system over the last fiscal year is tabulated below. The domestic system excludes sales to West Kootenay Power & Light, Seattle City Light and export surplus, but includes domestic non-integrated areas (Zone II diesel districts).

The actual peak demand increase was higher than for energy due to an extreme cold weather period occurring in 1988/89.

	Actual 1987/88	Growth	Actual 1988/89	% Growth
Total Domestic Sales(GW.h)	35,679	1,615	37,294	4.5
Gross Requirements (GW.h)	40,404	1,787	42,191	4.4
Peak Demand (MW)	6,862	659	7,521	9.6
Weather Normalized Peak(MW)	7,135	195	7,335	2.8

SECTION 2 - ECONOMIC FORECASTS

2.1 SOURCE OF INPUTS

Information for preparation of the economic forecast comes mainly from the B.C. Ministry of Finance and Corporate Relations. Outside consultants provide specific input for the major (electric intensive) industrial sectors.

The 1989 long term economic forecast from the Ministry of Finance and Corporate Relations provided the base for projecting the overall provincial, sectoral and population growth.

Input provided by outside consultants included an outlook for the pulp and paper industry prepared by Woodbridge, Reed and Associates, a mining industry forecast from H.N. Halvorson Consultants and a background paper on the chemical industry by Canadian Resourcecon.

Electricity price projections are consistent with the 1989 Rate Application to ensure smooth rate increases over time and promote efficient use of electricity. Natural gas and crude oil price projections were based on input from Confer Consulting Ltd.

2.2 LIFESTYLE AND BUSINESS ENVIRONMENT

The outlook for the future, on which the probable economic and population forecasts are based, is for continuing changes in demographics, business structure and technology.

The major factors in demographic change are the 'greying' of population and further increase in the female participation rate in the work force. In the next 20 years the 35-54 age group is forecasted to be the dominant age-group. It will account for 30% of the population by the late 1990's, up from 26% in 1988. Historically this age group has had the highest income per capita as well as the highest propensity for spending. This suggests good demand in the retail sector. By the year 2000 the female participation rate is forecasted to increase to 68% from 65% in 1988. Because of the increase of female participation in the work force, many chores in maintaining the household, once done by unpaid housewife time, are now either purchased in the market place or shared between the spouses. The net result, however, is an overall decrease in free time. This reduction in personal free time has a significant effect on the way we demand services. People will prefer more time saving devices such as dishwashers, microwave ovens etc., and people will prefer conveniences such as one stop shopping at super-stores or malls.

There are also significant changes occurring in the business world, e.g. the Free Trade Agreement, de-regulation of the financial industry, Vancouver becoming an international banking center and the increasing emphasis on trade with Pacific Rim countries. All these changes will significantly affect the way we do business. To stay competitive, B.C.'s businesses will have to aggressively pursue improvements in productivity. This is where technology comes in, especially information technology. This technology will help us save time by 'cutting' geographic distances and by doing things faster. By the year 2000 it is projected that every white collar worker will have a "screen" at his/her workstation and 35% of homes will have a personal computer (PC). If this projection is realised there will be more than one and half million PC's or "screens" in use in B.C. This proliferation of PC's will directly affect the way we lead our daily life as well as the delivery of services in the commercial sector.

Customers' needs and technological innovations drive each other. Technological innovations are responding to customers' needs and at the same time providing an opportunity for doing things in

a new way. This new way of doing things may well affect the historical relationships established and used in our forecast methodology e.g. the relationship between GDP growth and electricity use growth in certain sectors. Thus required is a continuing review and re-estimation of forecast parameters.

In summary, a scenario of a high-tech society employing many electricity using devices is adopted, a scenario in which increasing productivity is a major concern. Businesses will have to increase productivity to be more competitive. Individuals will want to increase productivity to maximize their free time.

2.3 PROBABLE ECONOMIC FORECAST

The probable economic forecast (Figure 2.1) contains an assumption of continuing stable economic conditions. Economic growth is expected to moderate over the next two years but retain a positive and relatively good pace in the long term. Inflation is forecast to be moderate with a slowly declining interest rate. The Canada-U.S. Free Trade Agreement should result in investment to improve efficiency and expand production for competing in the much larger U.S. market. Economic growth is forecast to average 2.8% over the period 1989 to 1999 and 2.3% in the following 10-year period to 2009.

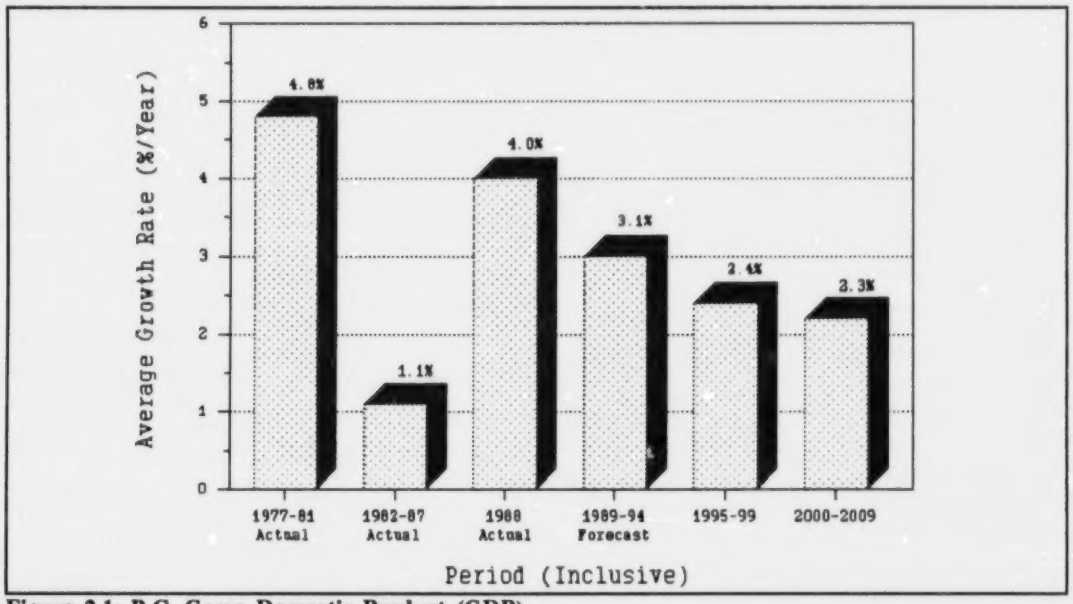


Figure 2.1: B.C. Gross Domestic Product (GDP)

2.4 POPULATION FORECAST

The population for B.C. is forecast to rise from 2,938,000 in 1988 to 3,582,900 in 1999, an annual rate of 1.6% and to 4,090,000 in 2009, an annual rate of 1.3%. Inter-provincial in-migration, the most volatile component of the population forecast, over the period is forecast to average over 20,000 due to a more optimistic view of the economic conditions in B.C. and livability as compared to the rest of Canada. International in-migration is expected to average an annual rate of 17,000 to the year 2009. See figure 2.2.

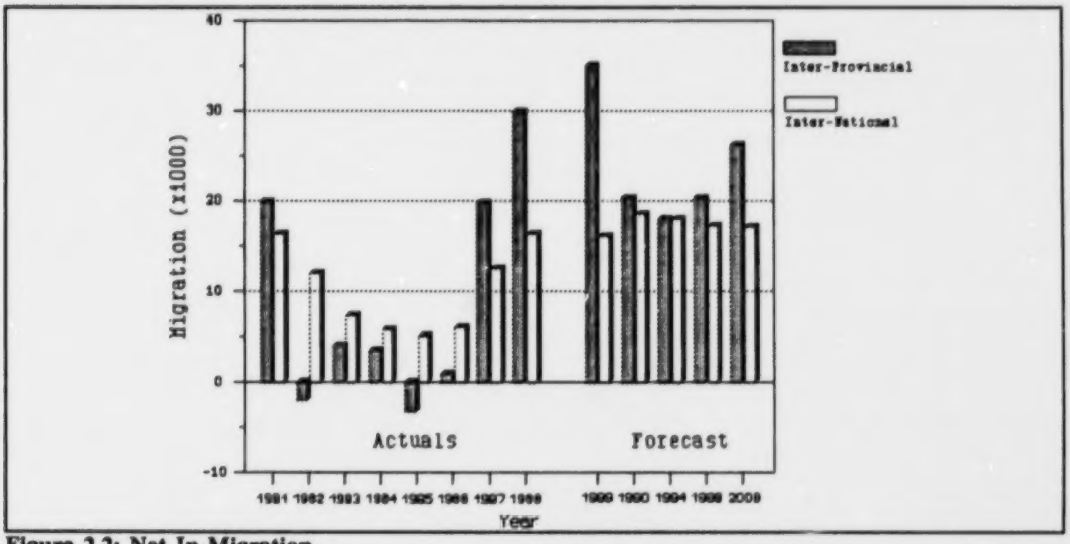


Figure 2.2: Net In-Migration

2.5 SECTORAL OUTLOOKS

The commercial sector is projected to expand faster than the industrial sector through the forecast period. The trend towards a more service oriented society will promote growth in the commercial sector while resource constraints (forest) and market conditions (mining) will limit long term growth in the industrial sector. See Figure 2.3.

The commercial sector presently accounts for 68% of total GDP. This is projected to increase to 70% by 1999 and 71% by 2009.

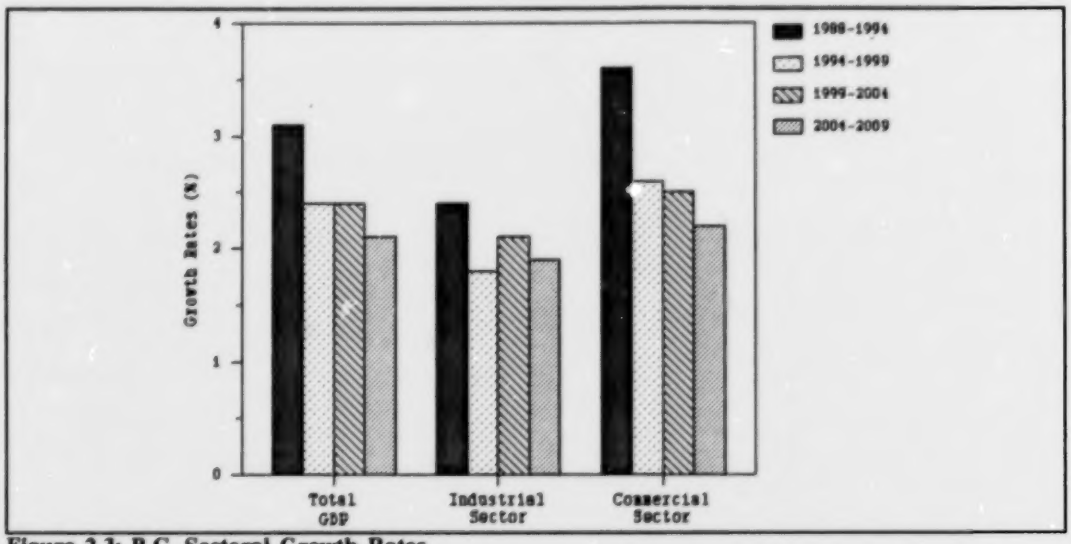


Figure 2.3: B.C. Sectoral Growth Rates

The outlook for the sub-sectors within the industrial and commercial sectors of key importance (i.e. electricity use) to B.C. Hydro follows:

2.5.1 Industrial Sector

Growth in the mining sector is projected to be limited. Long term prices for copper are projected to be considerably lower (in real terms) than at present. Prices will be such that new copper mine development will not be sufficient to offset production declines from closure of current mines due to ore depletion. Increased coal production will be limited by low prices and world excess capacity.

Wood products is B.C.'s most important manufacturing industry, but long term growth is limited by timber availability. Positive growth will result from better utilization of raw materials plus increased production of higher valued products.

Pulp and paper manufacturing is projected to eventually approach wood manufacturing as the most important manufacturing sector. Technological advances, particularly in mechanical pulping, are allowing for more and better use of existing raw material and for use of different wood species such as aspen. The present trend to mechanical pulp production and paper expansions is expected to continue in the future. A trend to higher valued paper products is also expected. Long-term growth is thus expected to be higher than for wood manufacturing but eventually also reach the limitation of available resource.

The electric intensive portion of the chemical manufacturing industry is primarily associated with the kraft pulp sector. The trend to mechanical pulping, with considerably less chemical requirements, will limit new chemical production. The industry, however, is currently undergoing a major realignment. The replacement of chlorine for bleaching with chlorine dioxide in the pulp and paper industry is seeing a considerable amount of new sodium chlorate capacity being installed. As chlorine is produced jointly with sodium hydroxide and there is a requirement for the sodium hydroxide, new markets must be found for the excess chlorine.

The highest growth sector in the industrial area is projected to be in non-resource based manufacturing which includes the rapidly developing high technology industries.

2.5.2 Commercial Sector

The wholesale and retail trade sector is forecast to have the highest growth rate followed by the services sector. Within the services sector, tourism, along with personal and business services, are projected to be the main growth areas.

2.6 ALTERNATIVE ECONOMIC SCENARIOS

In addition to the forecast probable economic scenario, as discussed in Section 2.3, the Ministry of Finance and Corporate Relations also provided low and high economic forecast scenarios.

The low scenario incorporates a recession into the 1990 through 1992 period before returning to moderate economic growth in 1993.

The high scenario assumes a recession (in the short term) is averted and growth rates are sustained that are consistently higher than the probable scenario through the 1990's.

2.7 ENERGY PRICES

The **electricity price** forecast is consistent with the 1989 Rate Application to ensure smooth rate increases over time and promote efficient use of electricity. This year's projection for electricity prices is for a decline in real terms of 1.5% per year for the first 10 years and to remain flat in real terms (i.e. increases at the rate of inflation) thereafter. The result by 1998 is a real price decline of approximately 14%.

The perspective for **crude oil prices** in the long term remains uncertain. However, equilibrium levels of long-term crude oil prices are projected to fall between U.S. $15 and $20 per barrel (1989$). Crude oil prices below or above this range will impact supply and demand in a manner which will return prices to the US $15 to $20 per barrel range. For this forecast, oil price are assumed to remain flat, in real terms, for 5 years and then increase at 1% per year.

Natural gas prices will be a function of both market forces and the resolution of industry constraints. In the long term natural gas prices are expected to increase relative to crude oil prices. The fundamental reason for the relative price rise is that North American natural gas markets will tighten before world crude oil markets tighten because the world crude oil production surplus is considerably greater than the North American gas deliverability surplus. The wellhead price is thus expected to begin rising significantly in real terms. Distribution costs, however, are expected to remain constant. The result assumed for this forecast is an overall increase of 1.25% per year in real terms.

The long-term effect of the outlook for electricity, crude oil and natural gas price is illustrated for the residential sector in Figure 2.4. The graph shows efficiency adjusted costs for residential heating fuels with present Lower Mainland prices used. Light fuel oil and natural gas are expected to remain close to the same relative position. Electricity, however, will become relatively cheaper but not to the point of being competitive with natural gas. Thus no significant change in the pattern of fuel use is projected. This same outlook is assumed for the competitive areas within the commercial and industrial sectors.

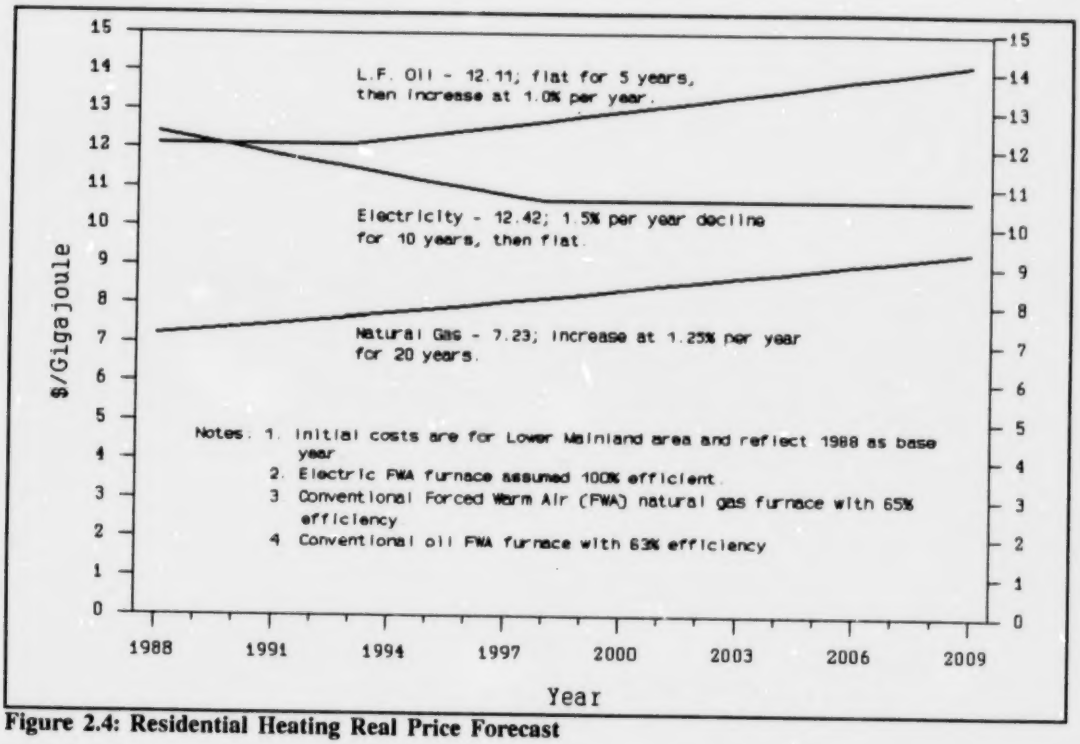

$/Gigajoule
Year
L.F. Oil - 12.11; flat for 5 years, then increase at 1.0% per year.
Electricity - 12.42; 1.5% per year decline for 10 years, then flat.
Natural Gas - 7.23; increase at 1.25% per year for 20 years.
Notes. 1. Initial costs are for Lower Mainland area and reflect 1988 as base year
2. Electric FWA furnace assumed 100% efficient.
3 Conventional Forced Warm Air (FWA) natural gas furnace with 65% efficiency
4 Conventional oil FWA furnace with 63% efficiency
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
1988 1991 1994 1997 2000 2003 2006 2009

Figure 2.4: Residential Heating Real Price Forecast

SECTION 3 - PROBABLE ELECTRIC FORECAST

The Probable Electric Forecast, as described in this section, encompasses B.C. Hydro's integrated and non-integrated (primarily diesel generation) areas plus firm export and inter-utility commitments. As such, firm sales to West Kootenay Power and Light and Seattle City Light (under the Skagit agreement) as well as Point Roberts and Hyder in the U.S. and to Alberta Power in the Peace River are included. Excluded are out of Province interruptible sales.

As well, the Interruptible Marketing (E+) and Demand Side Management (Power Smart) programs are not included in the forecast. They are discussed in Section 5 and must be subtracted or added to arrive at the forecast required for a particular planning consideration. They are not included here primarily because of the interruptible nature of the E+ programs and the use of the Power Smart programs as energy sources by Resource Planning.

The Forecast is prepared in detail, i.e. on a year-by-year basis for the first 10 years (through 1999/2000). The following 10 years (through 2009/10) rely on trend projections tied to the long-term economic outlook with no specific timing of projects assumed. The discussion in this section deals primarily with the first 10 years of the forecast.

3.1 1989 PROBABLE FORECAST

Total gross requirements are projected to increase from 42,612 GW.h in 1988/89 to 58,920 GW.h in 1999/2000 and 73,920 GW.h in 2009/10 for an annual average growth rate for the 20-year period of 2.7%. Table 3.1 provides details of the projections by the major forecast components (sectors). Figure 3.1 provides a graphical representation for key years.

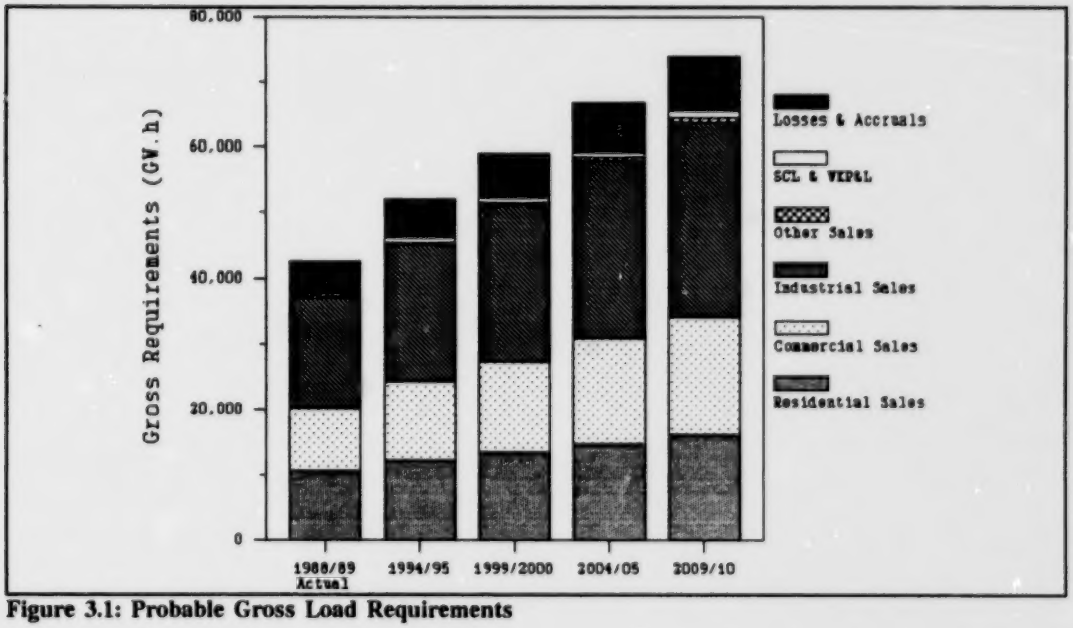


Figure 3.1: Probable Gross Load Requirements

Table 3.1
B.C. HYDRO PROBABLE GROSS LOAD REQUIREMENTS BY MAJOR SECTORS
(Including SCL & WKP&L)

	Residential (GW.h)	Commercial (GW.h)	Industrial (GW.h)	Other (GW.h)	WKP&L (GW.h)	SCL (GW.h)	Total Sales (GW.h)	Losses/ Accruals (GW.h)	TOTAL GROSS REQ'TS (GW.h)	Less Non-Integr. (GW.h)	INTEGR. SYSTEM TOTAL GROSS REQ'TS (GW.h)	INTEGR. SYSTEM PEAK (MW)
				(1)			(2)					
Actual												
1985/86	9793	8315	14571	281	41	134	33135	4289	37424	166	37258	6816
1986/87	9665	8678	15365	286	16	320	34330	3971	38301	167	38135	6567
1987/88	9902	9060	16426	291	77	312	36068	4725	40793	165	40628	7060
1988/89	10700	9569	16713	312	109	312	37715	4897	42612	176	42436	7765
Forecast												
1989/90	10959	9966	17519	321	230	318	39313	5068	44380	172	44210	7870
1990/91	11257	10384	18173	331	332	318	40795	5256	46050	172	45880	8150
1991/92	11555	10784	19018	341	400	318	42416	5450	47870	175	47700	8360
1992/93	11839	11190	19613	351	273	318	43584	5601	49190	180	49010	8590
1993/94	12113	11563	20286	362	288	318	44930	5772	50700	184	50520	8850
1994/95	12373	11894	20865	372	302	318	46124	5923	52050	187	51860	9080
1995/96	12630	12283	21583	384	306	318	47504	6094	53600	191	53410	9350
1996/97	12870	12700	22143	396	326	318	48753	6255	55010	195	54820	9600
1997/98	13113	12941	22662	407	344	318	49785	6386	56170	199	55970	9810
1998/99	13349	13368	23235	420	361	318	51051	6548	57600	203	57400	10060
1999/00	13588	13801	23691	433	381	318	52212	6709	58920	207	58710	10310
Avg. Ann.% incr. 11 years:												
88/89-99/00	2.2%	3.4%	3.2%	3.0%	12.0%	0.2%	3.0%	2.9%	3.0%	1.5%	3.0%	2.6%
2000/01	13848	14331	24378	446	407	318	53728	6899	60630	211	60420	10610
2001/02	14109	14664	25083	460	433	318	55067	7063	62130	215	61920	10870
2002/03	14369	15082	25796	474	459	318	56498	7241	63740	220	63520	11140
2003/04	14632	15499	26460	488	487	318	57884	7416	65300	224	65080	11420
2004/05	14899	15897	27132	503	518	318	59267	7590	66860	229	66630	11690
2005/06	15172	16300	27744	516	553	318	60603	7761	68360	233	68130	11960
2006/07	15438	16713	28313	529	594	318	61905	7928	69830	238	69590	12210
2007/08	15706	17128	28831	542	635	318	63160	8093	71250	243	71010	12470
2008/09	15969	17540	29310	556	686	318	64379	8254	72630	247	72380	12720
2009/10	16231	17924	29738	570	735	318	65516	8407	73920	252	73670	12940
Avg. Ann.% incr. 10 years:												
99/00-09/10	1.8%	2.6%	2.3%	2.8%	6.8%	0.0%	2.3%	2.3%	2.3%	2.0%	2.3%	2.3%
21 years:												
88/89-09/10	2.0%	3.0%	2.8%	2.9%	9.5%	0.1%	2.7%	2.6%	2.7%	1.7%	2.7%	2.5%

Notes:

1. Inter-Utility transfers (excluding WKP&L) and firm export (excluding SCL).
2. Interruptible Marketing (E+) and Demand Side Management (DSM) programs not included in Forecast numbers but are included in Actuals.

Residential sales are projected to be the slowest growth sector. The continuing efficiency improvements in appliances and the high saturation of (and limited introduction of new) electric intensive appliances are the primary reasons for the conservative growth projections in usage per account. The natural gas pipeline to Vancouver Island will slow the growth of electric heating accounts.

Commercial sales are projected to grow faster (long term) than both the other major sectors of residential and industrial. The driving factor is the continuing addition of (relatively) new applications such as office automation, personal computers, etc. The result is a continuing increase in use of electricity by existing customers.

Industrial sales growth is projected to be driven by the pulp and paper sector through the early 2000's when resource availability will limit growth. Mining load is expected to show negative growth with closure of many existing copper mines in the 1990's. New sales are anticipated from the area of smelting, chemicals and new manufacturing. An underlying factor is the continuing trend to improving productivity via the increased use of electricity.

Figure 3.2 compares the projected growth rates of the residential, commercial and industrial sectors.

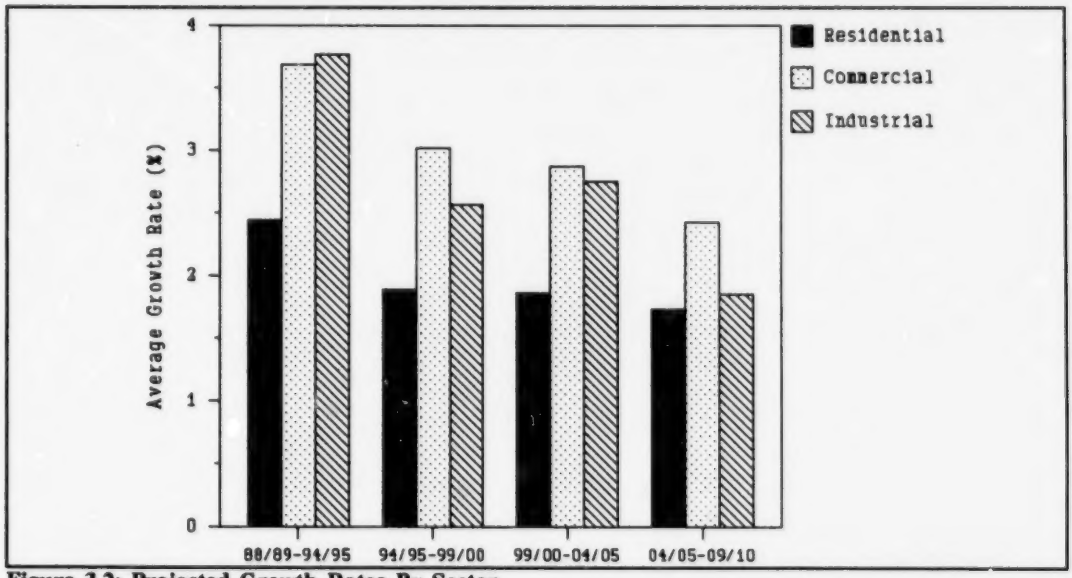


Figure 3.2: Projected Growth Rates By Sector

Of the remaining sales, the largest increase is in the requirements for West Kootenay Power and Light (see Section 3.5).

The peak demand (in MW) shown is for the integrated system since most planning functions consider the peak at this level. The growth in peak demand (from a weather normalized base) is expected to closely parallel the growth in energy requirements. No discernible change in the annual system load factor is evident from recent history. Influences will come, however, from changing load patterns due to Demand Side Management programs and continuous monitoring will be necessary.

Existing load and projected growth to 1999/2000 by B.C. Hydro's four Divisions is shown in Figure 3.3. The Lower Mainland presently accounts for 46% of the total load. The Lower Mainland is projected to outpace the other Divisions in economic growth through the 10-year period with resulting faster growth in residential, commercial and small industrial sales. Overall Divisional sales growth is

distorted, however, by the location of new electric intensive industrial load, in particular pulp and paper. The Northern Division growth rate of 4.0% average would be less than 2.0% without the new projected pulp and paper load.

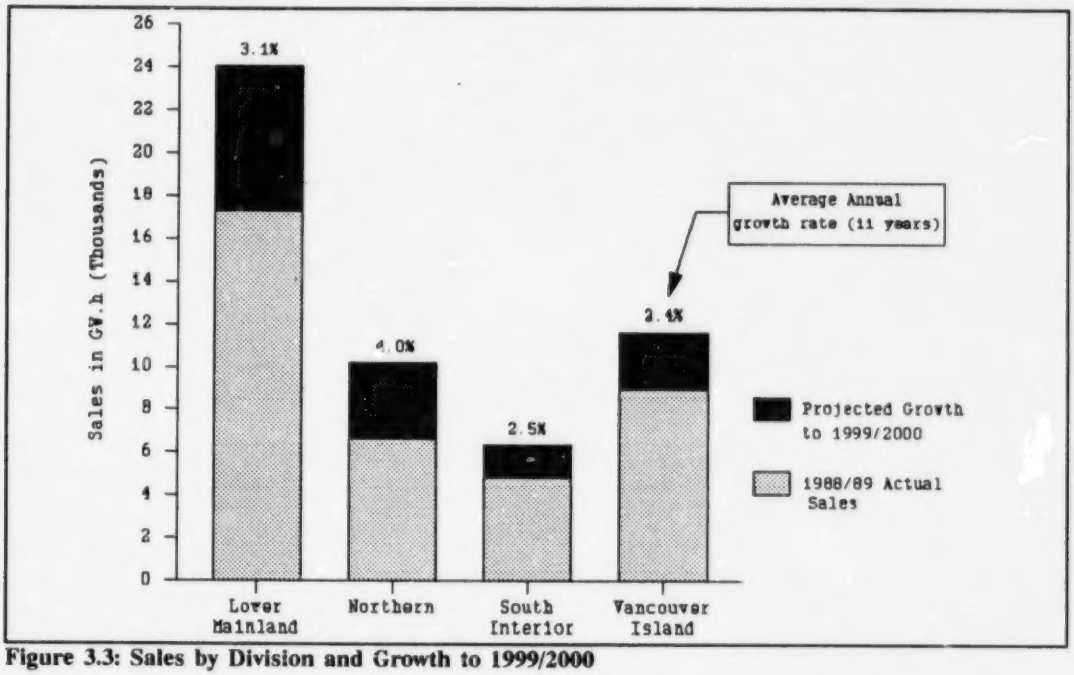


Figure 3.3: Sales by Division and Growth to 1999/2000

3.2 RESIDENTIAL SALES

In the fiscal year ending March 31 1989, residential sector sales amounted to 10,647 GW.h (plus 53 GW.h for E+) and accounted for 28% of B.C. Hydro's total billed sales. Residential sales are forecast to increase from 10,647 GW.h in 1988/89 to 13,588 GW.h in 1999/2000, representing an average annual growth rate of 2.2%. Continued growth in residential sales will be affected to a large extent by factors such as population increase, rate of household formation, type of dwelling unit (e.g. the large houses currently being built in the Lower Mainland), the share of accounts using electricity for space heating and the penetration rate of energy efficiency improvements. Details of the projections are provided in Table 3.2 below.

Table 3.2
RESIDENTIAL ELECTRIC SALES FORECAST
(Billed Basis, No Adjustment For Accrual)

Fiscal Year	Average Residential Accounts (000)	Percent Electric Heating (%)	Annual Average Use per Account: Non-Electric Heating (kW.h)	Electric Heating (kW.h)	All Accounts (kW.h)	Total Sales (GW.h)
ACTUAL						
1978/79	847.4	10.1	7,710	18,916	8,841	7,492
1986/87	1,033.6	18.2	8,299	14,068	9,351	9,665
1987/88	1,052.9	18.7	8,344	13,946	9,395	9,892[1]
1988/89	1,073.4	19.1	8,760	14,816	9,919	10,647[1]
Avg. Annual Growth (%) 10 years:						
78/79 - 88/89	2.4%		1.3%	-2.4%	1.2%	3.6%
FORECAST						
1989/90	1,096.6	19.4	8,824	14,864	9,994	10959
1990/91	1,120.0	19.7	8,880	14,833	10,051	11257
1991/92	1,144.4	20.0	8,930	14,760	10,097	11555
1992/93	1,169.8	20.4	8,966	14,629	10,120	11839
1993/94	1,194.6	20.7	9,003	14,495	10,140	12113
1994/95	1,219.0	20.9	9,037	14,354	10,150	12373
1995/96	1,243.2	21.1	9,073	14,218	10,160	12630
1996/97	1,267.2	21.2	9,099	14,075	10,156	12870
1997/98	1,290.9	21.4	9,128	13,953	10,159	13113
1998/99	1,314.2	21.5	9,157	13,817	10,158	13349
1999/00	1,337.5	21.6	9,187	13,694	10,160	13588
Avg. Annual Growth (%) 11 years:						
88/89 - 99/00	2.0%		0.4%	-0.7%	0.2%	2.2%

[1] Plus 8 GW.h in 1987/88 and 53 GW.h in 1988/89 for Interruptible Marketing (E+).

In projecting the number of residential accounts, age specific headship rates and dwelling preference factors are applied to the population forecast to distribute households by type of dwelling. B.C. Hydro's 1988/89 fiscal year average number of residential accounts of 1,073,379 is projected to increase to 1,337,440 by 1999/2000, an annual growth rate of 2.0% per year.

In developing the forecast for the number of residential customers with electric space heating, the short term is based on the Divisional customer projections. The longer term forecast is influenced by historical trends, relative energy prices, builder preferences (with regard to heating equipment and installation costs), the changing housing mix and the availability of alternate heating fuels.

Over the last 10 years, the number of residential customers using electric space heating has increased from 10.1% to 19.1% of total customers. This trend is projected to be much slower in the future. In the short term, transfer of some existing electric heating customers to the interruptible marketing (E+) rate (now closed) and thus out of the base forecast has slowed the trend. In the longer term, the natural gas pipeline to Vancouver Island will limit growth of heating customers. By 1999/2000 the share of electric space heating accounts is projected to rise only to 21.6%.

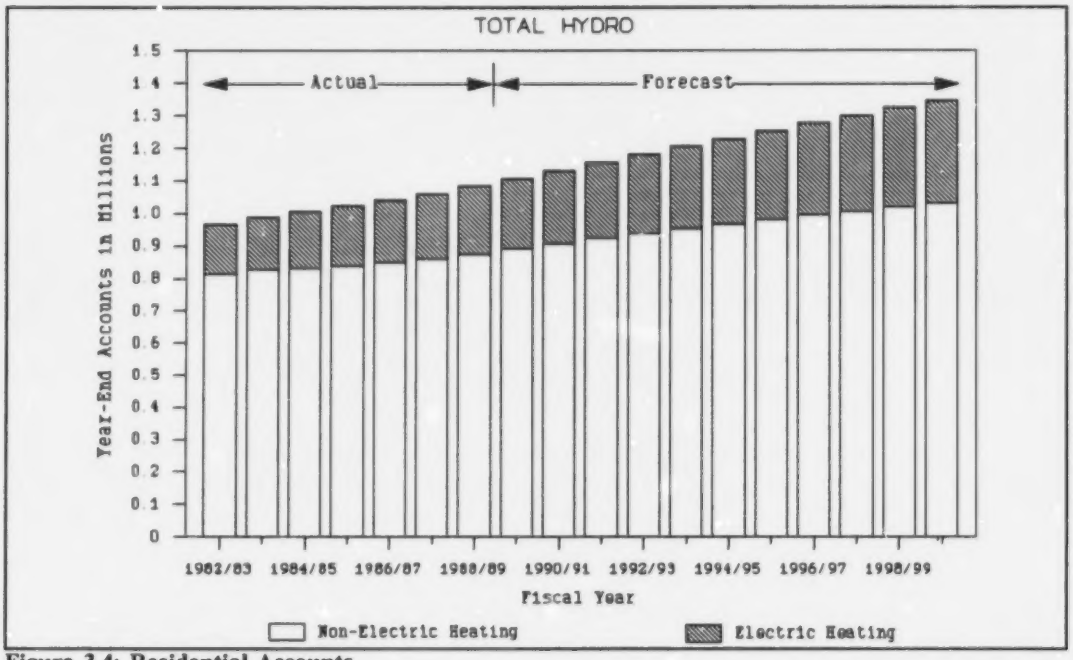


Figure 3.4: Residential Accounts

Average annual consumption (weather normalized) for non-electric space heating accounts is largely a function of household appliances and is starting to level out. This is due to improved appliance efficiencies and the approaching saturation of many electric intensive appliances such as refrigerators and freezers. With a continuing decline in real electricity prices forecast, further conservation improvements of a significant magnitude will depend on influences from the Power Smart programs. Non-heating average annual use is forecast to increase from the current 8,760 kW.h per year to 9,187 kW.h per year by 1999/2000. The increase will be due to increase penetration of entertainment and labour saving devices (individually not electric intensive).

Average use for space heating accounts has been declining on a weather normalized basis. Increasing penetration of wood stoves and their level of use has contributed to that effect. In this forecast average use for space heating accounts is expected to continue to decline. This is a result of more efficient appliances; new electrically heated houses which are better insulated; and a trend away from single family dwellings towards (smaller) apartments and row houses.

Figure 3.5 illustrates the sales forecast by non-heating/heating accounts.

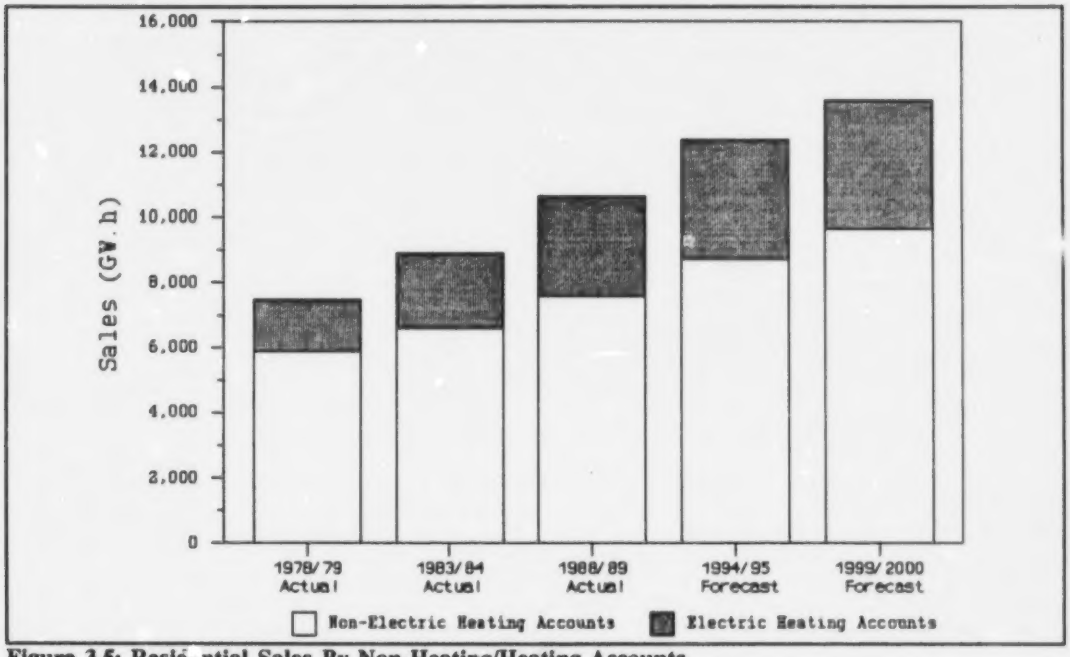


Figure 3.5: Residential Sales By Non-Heating/Heating Accounts

3.3 COMMERCIAL SALES

Sales to the Commercial Sector are forecast to grow from 9,569 GW.h in 1988/89 to 13,801 GW.h in 1999/2000 for an average annual growth rate of 3.4% per year. The commercial sector share of sales will increase from 25% to 26%. See Table 3.3 which details the commercial forecast.

Table 3.3
COMMERCIAL ELECTRIC SALES FORECAST
(Billed Basis, No Adjustment For Accrual)

Fiscal Year	By Standard Industrial Classification (SIC) Transportation Communication & Other Utilities (GW.h)	Wholesale & Retail Trade (GW.h)	Finance, Insurance & Real Estate (GW.h)	Community, Business & Pers. Serv. (GW.h)	Public Admin. & Defence (GW.h)	Unclass-ified (GW.h)	Less Impact of Gas on V.I. (GW.h)	Total Sales (GW.h)
1987/88 (Actual)	1,376	2,149	1,737	3,002	678	118	0	9,060[1]
1988/89 (Actual)	1,439	2,269	1,855	3,175	707	124	0	9,569[1]
FORECAST								
1989/90	1,449	2,396	1,933	3,326	739	123	0	9,966
1990/91	1,510	2,511	2,006	3,460	770	127	0	10,384
1991/92	1,568	2,616	2,081	3,599	798	130	8	10,784
1992/93	1,620	2,725	2,160	3,743	823	134	15	11,190
1993/94	1,668	2,840	2,242	3,854	849	137	27	11,563
1994/95	1,714	2,941	2,248	4,018	872	139	38	11,894
1995/96	1,765	3,044	2,321	4,164	894	143	48	12,283
1996/97	1,817	3,155	2,398	4,321	920	147	58	12,700
1997/98	1,849	3,215	2,449	4,414	934	148	68	12,941
1998/99	1,904	3,328	2,529	4,576	958	152	79	13,368
1999/00	1,957	3,445	2,611	4,738	983	156	89	13,801
Avg. Annual % incr. 11 years: 88/89-99/00	2.8%	3.9%	3.2%	3.7%	3.0%	2.1%	-	3.4%

[1] Includes Interruptible Marketing (E+) actual sales.

The Commercial sector is divided into six components, they are:

- Transportation, Communication and Other Utilities
- Trade (Wholesale and Retail)
- Finance, Insurance and Real Estate (FIRE)
- Community, Business and Personal Services
- Public Administration (Government Services)
- Unclassified

The trade and service components are projected to have the highest growth rates, followed by the FIRE component. See Figure 3.6.

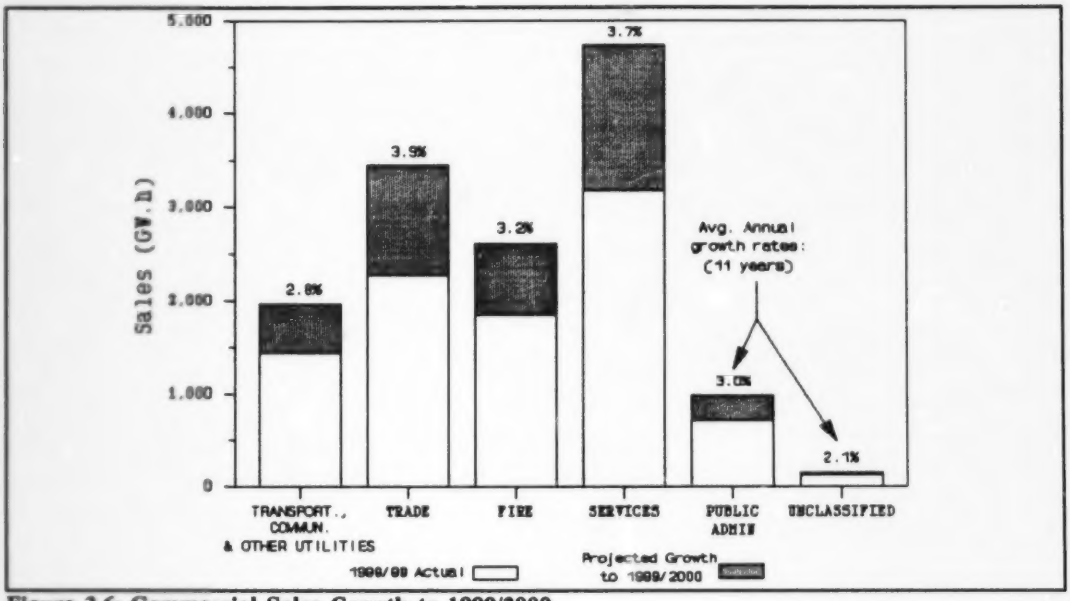


Figure 3.6: Commercial Sales Growth to 1999/2000

Commercial electricity sales depend on floor stock in the various components (or sub components). Population is the driver of floor space for services for people such as education and health care. Sectoral GDP is the driver of floor space in the remaining areas e.g. office space, tourism facilities, etc.

Electricity consumption trends (i.e. electricity usage per unit of floor stock) are projected to continue to increase. Efficiency improvements in lighting (presently accounting for 44% of commercial sector electricity usage) and motors (36% of present commercial sector usage) are being offset by relatively new applications such as office automation and personal computers.

The overall result is growth in sales to the commercial sector forecast to grow marginally faster than commercial sector GDP and to grow faster than both residential and industrial sales.

3.4 INDUSTRIAL SALES

Sales to the industrial sector are dominated by the forest industry and related sectors (figure 3.7): paper and allied products, wood manufacturing and chemicals (produced for the pulp and paper industry). This dominance will continue to increase until wood resource availability limits growth in the early 2000's. The mining sector is currently also a major user of purchased electricity but this will decrease with the assumed decline of copper/molybdenum production in B.C.

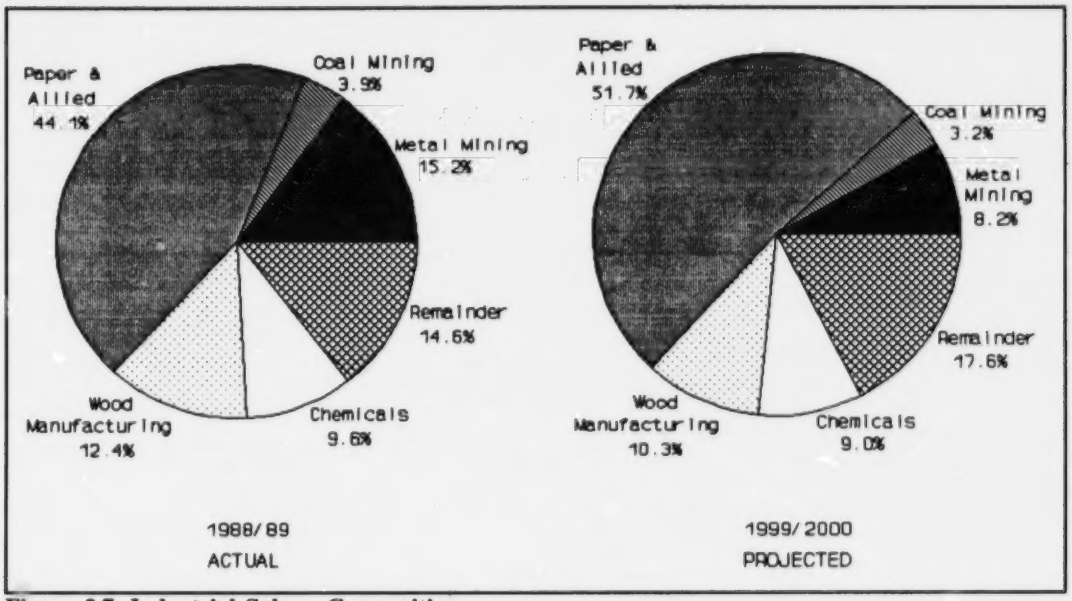


Figure 3.7: Industrial Sales - Composition

Total sales to the industrial sector are projected to increase by 6,978 GW.h between 1988/89 and 1999/2000 for an average annual growth rate of 3.2%. The breakdown of sales is by Standard Industrial Classification (SIC) which correspond to industrial sectors in the economic forecast. Table 3.4 provides details of the forecast by the major sectors. Figure 3.8 provides a graphic comparison of sales and growth by the various sectors.

Table 3.4
INDUSTRIAL ELECTRIC SALES FORECAST
(Billed Basis - No adjustment For Accrual)

	By Standard Industrial Classification (SIC)								
	Primary Industries			Manufacturing				Const.	
Fiscal Year	Metal Mines (GW.h)	Coal Mines (GW.h)	Other (GW.h)	Wood (GW.h)	Paper & Allied (GW.h)	Chemical (GW.h)	Other (GW.h)	(GW.h)	Total (GW.h)
1986/87 Act.	2,443	582	261	1,719	6,927	1,471	1,684	175	15,365
1987/88 Act.	2,536	630	289	1,987	7,250	1,644	1,804	180	16,426[1]
1988/89 Act.	2,540	660	323	2,077	7,377	1,612	1,807	186	16,713[1]
FORECAST									
1989/90	2,628	645	329	2,040	8,055	1,740	1,762	190	17,519
1990/91	2,798	675	336	2,070	8,335	1,822	1,817	190	18,173
1991/92	2,679	685	343	2,110	8,935	1,954	1,992	190	19,018
1992/93	2,509	705	350	2,150	9,395	2,021	2,158	190	19,613
1993/94	2,465	735	357	2,190	9,805	2,068	2,339	192	20,286
1994/95	2,570	745	364	2,230	10,095	2,071	2,455	195	20,865
1995/96	2,676	750	371	2,270	10,515	2,073	2,591	197	21,583
1996/97	2,556	750	378	2,310	10,955	2,090	2,765	199	22,143
1997/98	2,392	755	386	2,350	11,375	2,107	2,955	202	22,662
1998/99	2,237	755	394	2,390	11,810	2,119	3,186	204	23,235
1999/2000	1,953	760	402	2,430	12,240	2,127	3,432	207	23,691
Avg. Ann.% incr. 11 years:									
88/89-99/00	-2.4%	1.3%	2.0%	1.4%	4.7%	2.6%	6.0%	1.0%	3.2%

[1] Includes Interruptible Marketing (E+) actual sales.

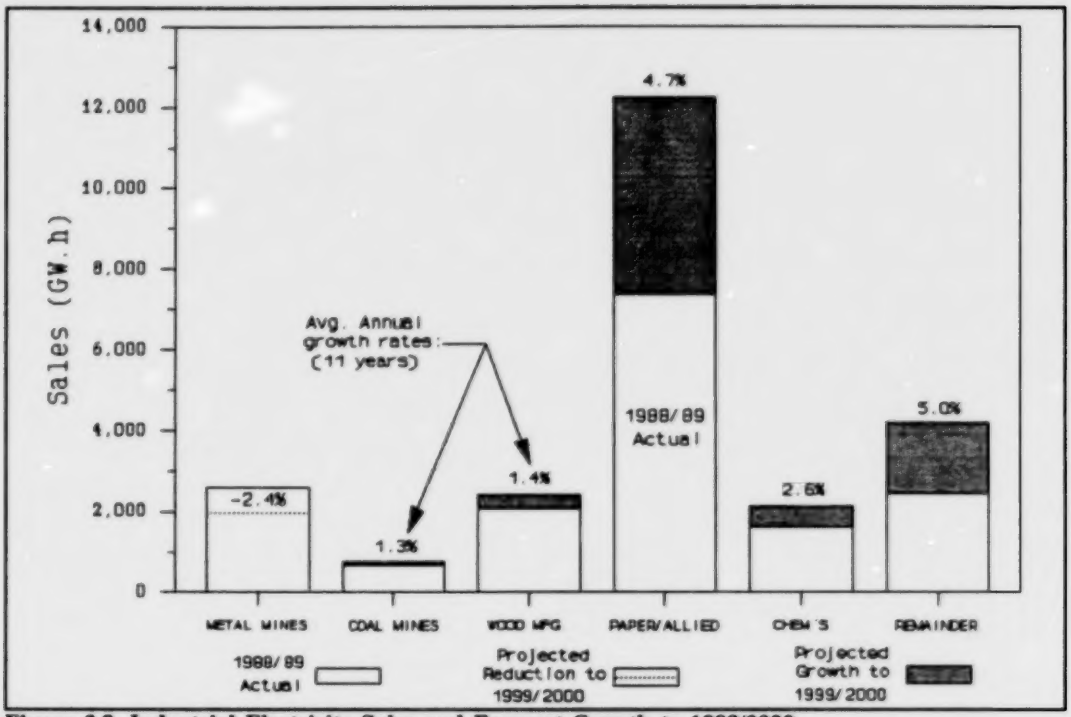


Figure 3.8: Industrial Electricity Sales and Forecast Growth to 1999/2000

3.4.1 Metal Mining

The major users of electricity here are the large open pit copper and molybdenum mines. At present nine operating copper/molybdenum mines account for 99% of the sales. By the late 1990's, seven of these mines are assumed to be closed with depletion of economic ore reserves. While copper prices are currently at high levels, the long term outlook is for lower copper prices. This will limit the development of major new copper/-molybdenum mines in B.C. Assumed in this forecast is the development of one new mine, Mount Milligan and the reopening of two, Goldstream and Kitsault. While considerable development of gold/silver mines is anticipated, they are relatively small users of purchased electricity. The expected result is a long term decrease in electricity sales to this sector (see Figure 3.9).

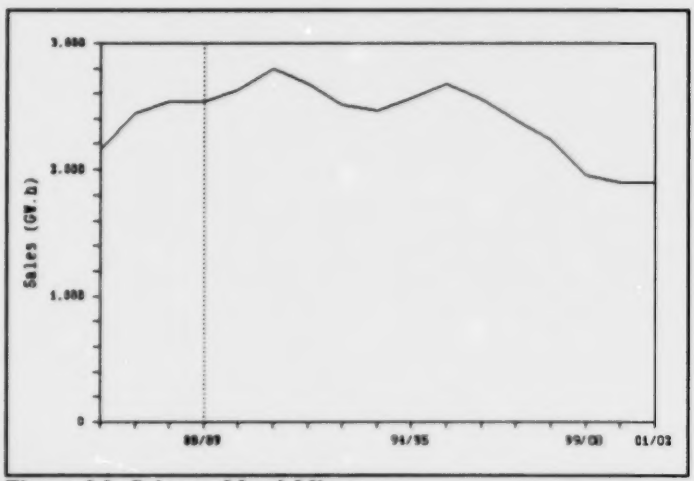


Figure 3.9: Sales to Metal Mines

3.4.2 Coal Mines

Contained here are the large, open pit coal mines (presently seven in total) accounting for the total load. Little change in operating levels is forecast through the period, however, two new thermal coal mines, Quinsam (on Vancouver Island) and Telkwa (near Smithers) are assumed to come on line. Total sector load is shown in Figure 3.10.

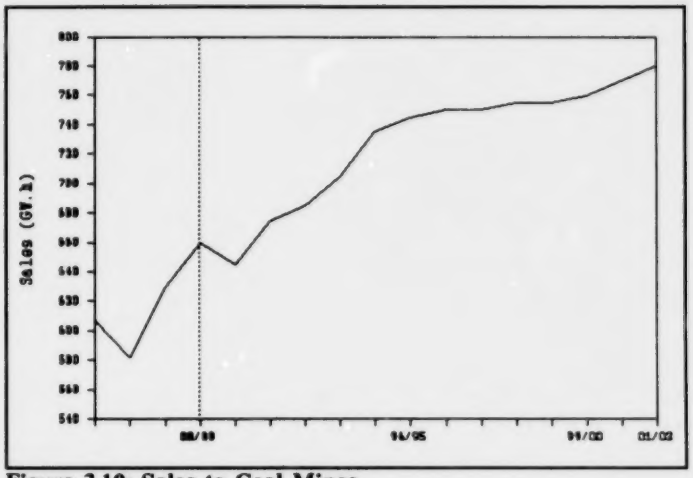


Figure 3.10: Sales to Coal Mines

3.4.3 Wood Manufacturing

Sales to the wood manufacturing sector (Figure 3.11) are assumed to remain flat over the next couple of years with the projected slowdown in the North American economy. U.S. housing starts are lower and this has the effect of dampening lumber prices as well as requirements. Long-term production growth is limited by the allowable annual cut. Sales growth will occur largely from technological improvements generally involving increased electricity usage, additional electric wood drying and additional value added production.

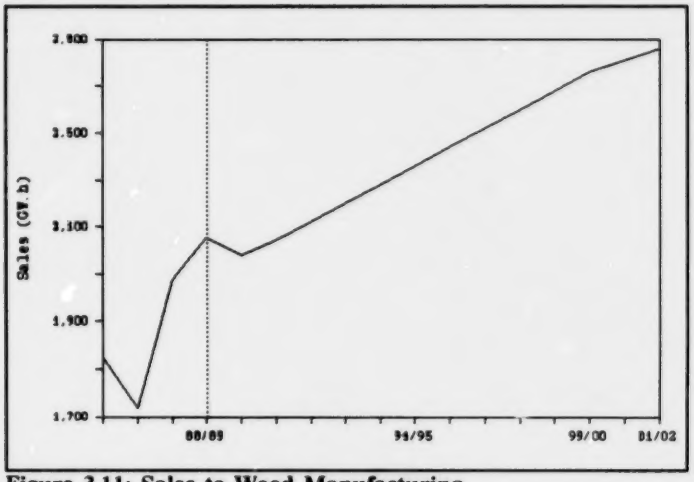


Figure 3.11: Sales to Wood Manufacturing

3.4.4 Paper and Allied Products Manufacturing

The paper and allied products sector is the largest user of purchased electricity in the industrial area. In 1988/89, the 7,377 GW.h purchased by the industry accounted for 44% of industrial sales and 20% of total sales. By 1999/2000, sales are projected to be 12,240 GW.h (Figure 3.12) and account for 52% of industrial sales and 23% of total sales. Thus, the significance of the sector to B.C. Hydro is projected to further increase. It is not until after the turn of the century, when expansion becomes limited by resource availability, that its significance will start to decrease.

Of the 22 customers that account for 99% of the load in this sector, ten have recently or are in the process of adding new load (one is a new customer - FIBRECO). Also, one new (greenfield) mill (Louisiana Pacific) is being built. Between early 1989 and late 1992 over 2,000 GW.h of load will be added to B.C. Hydro's system. In addition, 700 GW.h of co-generation is being installed by Howe Sound Pulp. The additional load is projected despite the assumption that operating rates for the industry will decrease from the 100% over the last couple of years to 90% (average long term rate).

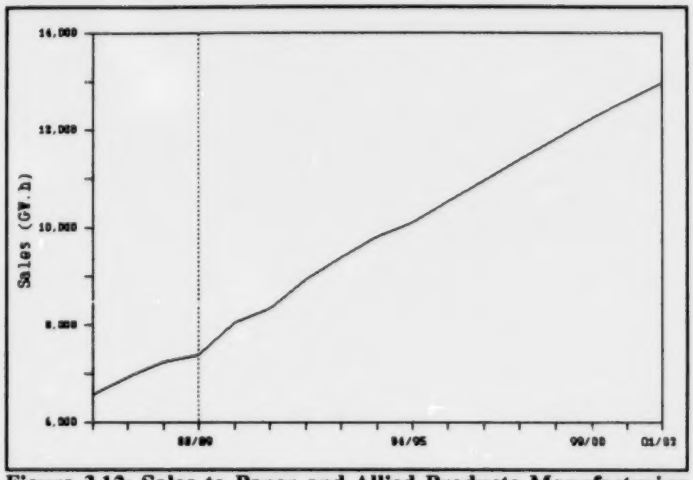


Figure 3.12: Sales to Paper and Allied Products Manufacturing

Another cyclical expansion phase is projected for the mid to late 1990's. An additional 3,000 GW.h of load is anticipated, the equivalent of 5 market CTMP or CTMP/newsprint mills.

The large increase in electricity purchases is not so much due to increased production as to the pulping technologies being used. Mechanical pulp in the form of Chemi-thermal Mechanical Pulp (CTMP) is now being extensively used in new paper production in B.C. as well as being sold as a market pulp. CTMP is much more electric intensive than kraft pulp, requiring in the order of 2,200 to 2,800 kW.h/tonne, and its production process does not lead to new co-generation being economically installed. Kraft (market) pulp requires only approximately 800 kW.h/tonne and a considerable portion is usually supplied from co-generation.

3.4.5 Chemical and Chemical Products Manufacturing

The six customers that produce chemicals for the pulp and paper industry, account for nearly 90% of sales to this sector. The production processes for sodium chlorate and chlorine/-caustic soda are very electric intensive. The other major customer in this sector is Ocelot's ammonia plant at Kitimat which accounts for another 7% of sales.

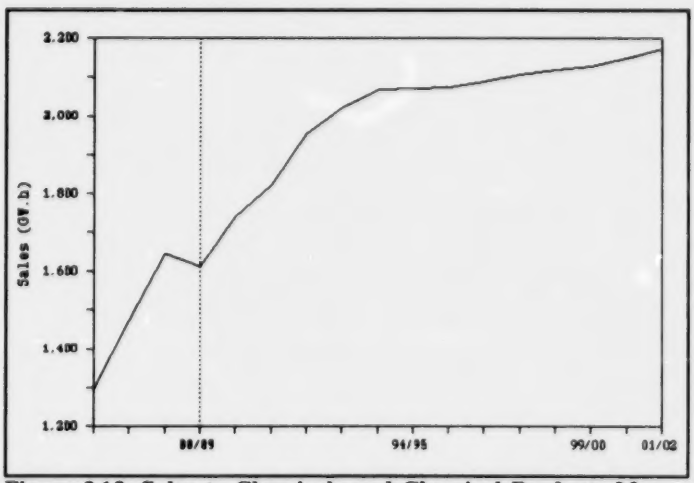


Figure 3.13: Sales to Chemicals and Chemical Products Man.

The chemical industry associated with the pulp and paper industry is currently undergoing a significant change. Chlorine usage in pulp

bleaching is being replaced by chlorine dioxide because of the environmental (dioxins) problems with chlorine. Chorine dioxide is being produced from sodium chlorate. To supply the new requirements, several expansions in sodium chlorate are currently underway.

Additional markets will be required for the excess chlorine. Chlorine is produced via the chlor-alkali process in fixed proportions and the requirements for alkali (sodium hydroxide) are projected to remain close to current levels.

Also presently being installed is a hydrogen peroxide plant. The hydrogen peroxide is to be used for mechanical pulp bleaching.

No change is expected in operation of the ammonia plant and no natural gas associated manufacturing facilities requiring significant amounts of electricity are projected through 1999/2000.

Overall, approximately 450 GW.h of new load is projected by the early 1990's. After that only moderate increases are forecast. Total sector sales are shown in Figure 3.13.

3.4.6 Remainder of Industrial

The industries here are, in general, smaller users of purchased electricity than the foregoing sectors. The sectors are forecast (separately) as shown in Table 3.5. Figure 3.14 illustrates the total of these remaining industrial sales.

Table 3.5
REMAINING INDUSTRIAL LOAD
SALES IN GW.h

	Other Pri Ind.	Food & Bev Man.	Pri Metal Man.	Non-Metallic Mineral Prod Man.	Pet. & Coal Prod Man.	Fabric. Metal Prod Man.	Misc. Man.	Const. Ind.	Non Spec Load	Total
Actual 1988/89	454	381	129	363	391	173	370	186	0	2447
Forecast 1994/95	504	437	400	345	383	200	640	195	50	3154
1999/00	542	487	410	390	399	226	929	207	600	4190
Avg. Annual Growth 11 years: 88/89-99/00	1.6%	2.3%	11.1%	0.7%	0.2%	2.5%	8.7%	1.0%	-	5.0%

The **Primary Metal Manufacturing** sector contains smelting of which little load is presently served by B.C. Hydro. The existing aluminum and lead/zinc load is served by self-generation (Alcan and Cominco) and any additional similar load is also assumed to be supplied by other than B.C. Hydro. The additional load shown served by B.C. Hydro by 1999/2000 is the assumption of a Ferrochromium smelter coming on line in the early 1990's.

Sales in the **Non-Metallic Mineral Products Manufacturing** sector is now primarily to the 3 large cement plants. The fiberglass plant at Mission closed in early 1989. Modest long term growth is projected.

The **Petroleum and Coal Products Manufacturing** sector contain the 7 major refineries which account for 95% of the load. Little growth in refinery load is anticipated and, in fact, one or more of the Lower Mainland refineries could close as they are small and relatively inefficient by present industry standards.

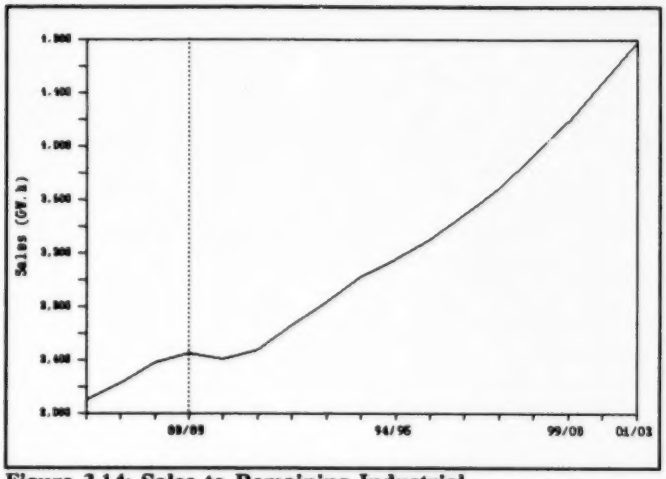


Figure 3.14: Sales to Remaining Industrial

Miscellaneous Manufacturing is largely non-resource based. While not electric intensive type load, e.g. high technology type industries, the growth rate is high in line with recent trends and the high sectoral GDP growth rate forecast for this area.

Non Specified Load is an allowance for unanticipated new load. The allowance is in line with historical trends for new load development.

The remaining sectors: **Other Primary Industries, Food & Beverage Manufacturing, Fabricated Metal Products Manufacturing** and the **Construction Industry** contain no large customers. Growth is projected in line with the particular sectoral GDP.

3.5 REMAINING SALES

Inter-utility and firm out of province sales make up the remainder of sales. See Table 3.6.

Two customers are included in inter-utility. The City of New Westminster purchases bulk and has their own distribution system. West Kootenay Power & Light (WKP&L) requirements will grow as their load increases. Their purchases include both energy associated with peaking capacity requirements and energy deficiencies anticipated. The B.C. Utilities Commission decision (in 1986) requires that WKP&L nominate annually their capacity and energy requirements from B.C.Hydro. Through 1990, a 5-year nomination is required with only the first two years binding. After 1990, a 10-year nomination is required with the first five years binding and the second five years constrained on a sliding scale from plus or minus 5% to 25% (6th through 10th years respectively).

There are 4 firm out of province contracts. Seattle City Light (SCL) sales under the Skagit agreement account for the majority of sales. They are at a set level. The other contracts are to Point Roberts in Washington, Hyder in Alaska and in the Peace River area to Alberta.

Table 3.6
REMAINING SALES (GW.h)

	Inter-Utility		Firm Out of Province				TOTAL
	New West.	WKP&L	SCL	Point Roberts	Hyder	Alberta	
1988/89 (act)	294	109	312	15	1	2	733
1999/00	408	381	318	22	1	2	1132
Avg Annual % Growth 11 Yrs.	3.0	12.0	-	3.5	-	-	4.0

3.6 GROSS REQUIREMENTS AND PEAK DEMAND

Gross requirements at the generation level are obtained by adding losses to the sales estimates. Losses are based on historical trends.

Energy losses are calculated in two steps. First, distribution losses as a percent of distribution sales of 6.9% are determined. Distribution sales encompass all customers not served directly at transmission voltage (60 kV or above). Secondly, transmission losses are calculated as 8.3% of the total of distribution sales, distribution losses and transmission sales. The overall result is total losses as approximately 13% of total sales.

West Kootenay Power and Light (WKP&L) and Seattle City Light gross requirements are calculated separately. Figure 3.15 shows the build-up to total gross requirements.

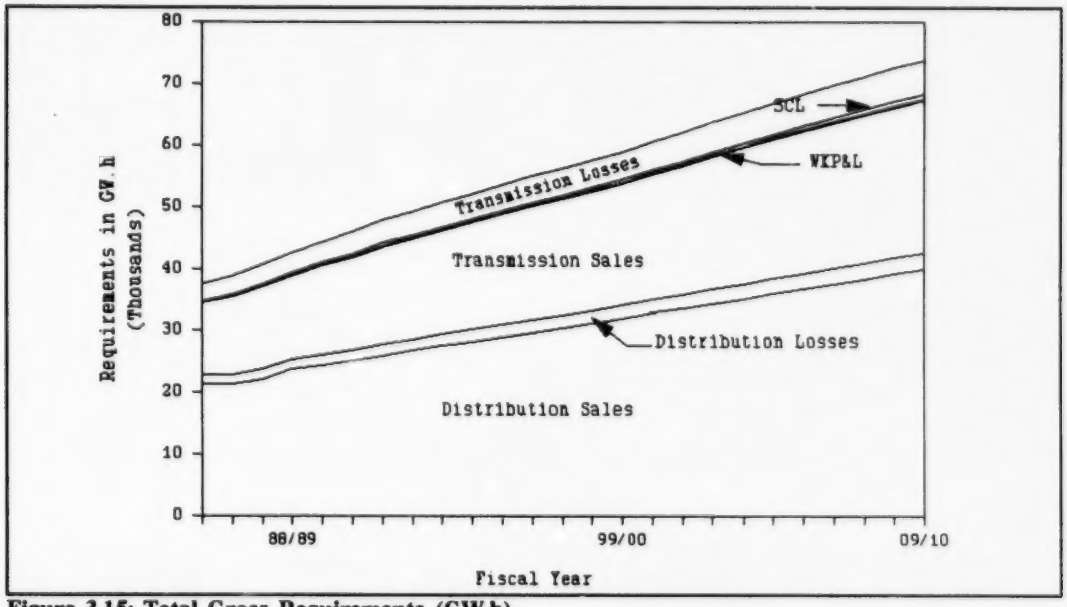


Figure 3.15: Total Gross Requirements (GW.h)

Peak demand is determined via the use of load factors that are based on historical trends.

Peak demand is calculated separately for the distribution customers and transmission customers. Distribution sales plus distribution and associated transmission losses are added and an annual load factor of 59.4% used to determine the peak contribution from distribution customers. Transmission customer sales plus associated transmission losses are added and an annual load factor of 80.0% used to determine their peak contribution. The additive result is a system load factor in the 65% to 66% range.

West Kootenay Power and Light (WKP&L) and Seattle City Light (SCL) peak impact are calculated separately.

Figure 3.16 shows the build-up to total peak demand.

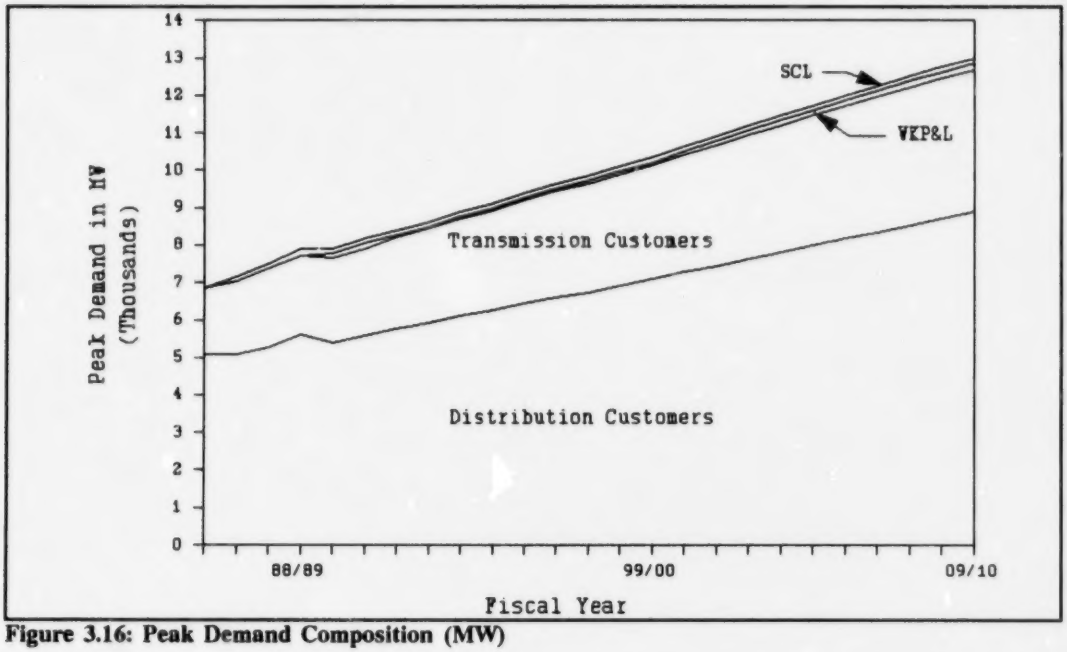


Figure 3.16: Peak Demand Composition (MW)

Projected requirements by WKP&L for energy deficiencies and peaking capacity are supplied by WKP&L. The SCL requirements for energy and peak capacity are per the Skagit agreement. System supply losses are added. For the peak requirements, diversity is allowed for; 95% for WKP&L and 70% for SCL. The considerable diversity for the SCL peak requirements reflects actual operation as SCL spreads out their limited energy take over an extended period of time.

SECTION 4 - ELECTRIC FORECAST UNCERTAINTY

There are two major components of uncertainty in the long term load forecast. The first is uncertainty in the future levels of major causal factors, e.g. economic conditions, energy intensity, etc, which determine the level of future electricity consumption. The second is uncertainty about the relationship between major causal factors and future electricity consumption, e.g. the relationships of economic activities and energy prices on energy consumption assumed in the present analysis may change over time.

In 1987, forecast uncertainty was demonstrated by developing a probability distribution around the probable load forecast, assuming provincial GDP and population growth held constant at the levels shown in the probable economic forecast. Thus, the probability distribution presented reflected uncertainties in variables such as future energy intensity and social trends but ignored the possibility of higher or lower overall economic growth. In the 1988 forecast the methodology was expanded to include all three economic scenarios (low, probable and high, see Section 2) thus reflecting the overall uncertainties implicit in the load forecast. Essentially the same range as developed for the 1988 forecast has been assumed for this year's forecast.

4.1 FORECAST PROBABILITY DISTRIBUTION

No detailed analysis was carried out for this year's forecast, thus only a general discussion of the process (1988) is provided here. Refer to SECTION 4 in the 1988 Forecast Document for a detailed description of the process.

Uncertainty in the Gross Load Requirements Forecast has been expressed in the form of a probability distribution in two steps. The first step describes the uncertainties around the probable forecast. The second step incorporates alternate economic forecasts.

4.1.1 Probability Distribution Around Probable Forecast

This distribution describes the full range of uncertainties in the forecast by integrating the uncertainties that arise sector by sector in the probable energy forecast given that the (economic) assumptions are fixed. The uncertainties that are inherent in each sector (assuming fixed input assumptions) were assessed by assigning subjective probabilities to key causal factors in each sub-sector. An uncertainty model employing Monte Carlo simulation methods was used to quantify and combine the probability distributions. The assessment was carried out for two specific years, 1993 and 1998. Variability increases substantially as the time to the forecast period increases. Similar probability distributions were calculated (extrapolated) for each forecast year. These distributions all assume that general economic forecasts, represented by Provincial GDP and population growth, remain unchanged.

4.1.2 Probability Distribution Incorporating The Three Economic Scenarios

The development of a probability distribution reflecting the three economic scenarios (the HIGH/PROBABLE/LOW) proceeded by developing high and low energy forecasts based on the high and low economic scenarios assuming the same energy intensity as the probable energy forecast. Then the extent of uncertainty associated with the high and low economic scenarios was assumed the same as the uncertainty surrounding the probable scenario, i.e. the low and high scenarios have the same variance and skewness as the distribution around the probable, but they differ in their means and medians. This assumption was adopted to allow proceeding in a pragmatic manner and beginning to examine the overall distribution associated with all three economic scenarios, even though we have not conducted detailed subjective elicitations for the low and high cases.

The probability of realization of the three different economic scenarios was evaluated with the expert in Central Statistics Bureau, Ministry of Finance and Corporate Relations (MF&CR). An overall probability distribution incorporating uncertainties with all three scenarios was then estimated.

The results of applying this (1988) range to this year's forecast is shown (for the integrated system) in Table 4.1. For each year, the Gross Load Requirements Forecast is shown as a series of five values:

(i) The 5th percentile. There is a 5% chance that the real value will be below this value.

(ii) The 25th percentile.

(iii) The 50th percentile (median). There are equal (50-50) chances that the real value will be lower or higher than this value.

(iv) The 75th percentile.

(v) The 95th percentile. There is a 5% chance that the real value will exceed this value.

Table 4.1
INTEGRATED SYSTEM PROBABILITY DISTRIBUTION
After Integration of Scenario Probabilities
(Gross Requirements GW.h)

Fiscal Year	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
1994/95	44,170	48,830	51,860	55,100	58,010
1999/2000	46,860	53,650	58,710	64,080	69,660
2004/05	49,050	58,330	66,630	74,150	83,330
2009/10	51,820	64,000	73,670	86,590	100,610

There is a 50% chance that the real value will fall in the interquantile range, between the 25th and 75th percentile values. There is a 90% chance that the real value will fall in the range between the 5th and 95th percentiles.

4.2 COMPARISON OF HISTORICAL FORECASTS

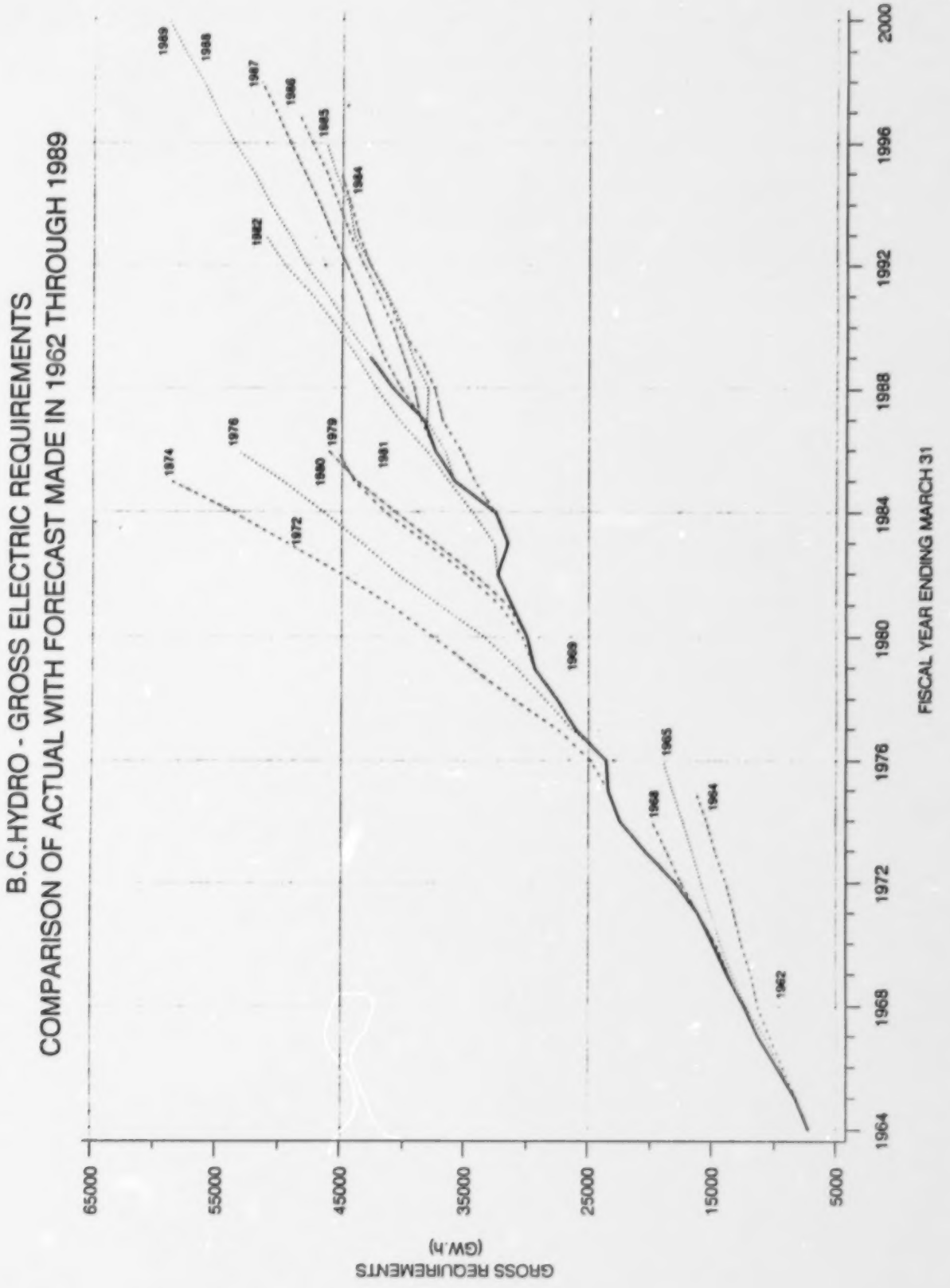
Table 4.2 shows the variance from actual growth in the probable energy forecasts prepared from 1963 on; Figure 4.1 is a graphical representation. Errors were magnified in the forecasts made from 1970 through 1975 because the second 5 years of those probable forecasts were trended to a high projection to ensure an adequate planning reserve.

TABLE 4.2
% ERROR*
YEARS AFTER FORECAST

Date Forecast Made	1	2	3	4	5	6	7	8	9	10	11
Sept. '63	-0.5	-3.5	-9.9	-16.4	-19.7	-24.8	-25.7	-28.1	-31.4	-35.6	-38.0
Sept. '64	-1.6	-3.1	-6.6	-8.0	-14.4	-15.6	-18.1	-22.8	-27.6	-31.3	-30.3
Sept. '65	-0.7	-3.4	0.0	-3.6	-4.5	-6.6	-11.6	-18.5	-22.7	-22.4	-19.5
Sept. '66	1.0	3.8	2.0	-0.5	0.1	-8.6					
Sept. '67	1.4	0.2	1.3	-0.2	-3.8	-9.5					
Sept. '68	-1.6	-1.9	-0.4	-2.6	-8.4	-11.7					
Sept. '69	0.1	1.9	-0.9	-4.4	-9.0	-7.4	-2.8	-7.0	-7.1	-7.4	-3.0
Sept. '70	-0.8	4.2	1.8	1.3	5.6	12.1	9.6	11.4	12.9	19.6	25.5
Sept. '71	0.6	0.9	1.2	6.7	14.7	12.5	15.0	16.5	23.8	29.5	35.7
Sept. '72	-1.8	-1.4	2.8	12.1	11.1	14.4	16.8	23.9	29.3	35.6	51.1
Sept. '73	0.5	4.8	14.0	13.0	17.7	20.5	29.5	36.7	43.5	60.1	68.8
Sept. '74	-0.5	5.3	5.3	12.7	16.7	25.2	31.2	38.9	56.3	64.8	63.5
Sept. '75	-0.6	2.2	5.0	9.9	18.6	26.1	32.6	49.1	58.2	57.2	63.7
Sept. '76	0.7	3.4	4.7	11.3	18.5	24.8	37.2	42.3	38.5	42.4	50.0
Sept. '77	0.4	-0.8	2.3	5.1	7.3	19.0	23.5	19.8	22.1	27.6	28.3
Sept. '78	-1.4	2.0	2.8	5.3	16.7	23.2	19.7	21.7	26.2	25.6	27.5
Sept. '79	1.2	3.0	7.6	20.7	27.1	22.5	21.1	24.1	22.0	22.5	
Sept. '80	0.9	5.6	18.5	24.5	21.9	22.9	26.0	25.3	24.7		
Sept. '81	-0.1	14.7	18.9	15.9	16.7	20.5	18.7	18.3			
Sept. '82	3.4	5.5	1.3	1.7	5.2	3.3	2.4				
Sept. '83	3.5	-0.6	0.3	1.5	-2.8	-3.7					
July '84	-4.7	-5.7	-4.0	-8.3	-9.5						
July '85	-2.2	-0.6	-6.9	-8.1							
July '86	0.6	-4.2	-6.3								
July '87	-1.6	-2.6									
July '88	-0.7										

* Difference between forecast made 1 to 11 years prior to year indicated divided by actual. A negative sign indicates the forecast was lower than actual.

Figure 4.3: B.C. Hydro's Gross Electric Requirements



SECTION 5 - MARKETING AND POWER SMART[1]

There are three sets of programs encompassed under Marketing and Power Smart. They are :

1) The Firm Industrial Marketing Programs;
2) The Interruptible Marketing Programs (E+); and,
3) Power Smart Programs.

Firm Industrial Marketing Programs

These programs were developed to market surplus electricity domestically and also, via reduced electricity rates, allow domestic industry to be more competitive and in some cases remain operating.

Load for the Firm Industrial Marketing Programs is included in the industrial sector forecast. For revenue estimates, however, the Marketing load must be separated out because of the various rates involved.

Interruptible Marketing Programs (E+)

The Interruptible Marketing Programs (E+) were introduced to provide reduced rates to domestic customers by marketing a portion of the secondary energy that is generally available with a hydro generation system.

Load for the Interruptible Marketing Programs (E+) has not been included in the base forecast discussed in this document. Since the load is interruptible under either energy or peak demand supply problems, it is being treated as an add-on for planning purposes.

Power Smart Programs

The Power Smart Programs are intended to reduce load growth by encouraging the more efficient use of energy.

Estimated load reductions from the Power Smart Programs have not been included in the base forecast discussed in this document. The programs are being treated as energy sources (similar to generation projects and other energy acquisitions) for resource planning. As well, future monitoring and evaluation of the programs will require they be treated distinctly from the base forecast.

5.1 FIRM INDUSTRIAL MARKETING PROGRAMS

There are presently two programs under which electricity sales are occurring. A third program, the Turbine Turndown (Rate 1844) program, which allowed the replacement of the customer's own generation from heavy fuel oil or wood waste/heavy fuel oil, was cancelled effective 31 March 1988. Table 5.1 shows sales for current and cancelled programs.

Industrial Electricity Rate Discount Act - Bill 28 (Rate 1845) involves rates and sales volumes negotiated on an individual customer basis and for varying lengths of time. The Act was introduced to promote increased production, expansion and new industry. Contracts have been negotiated with

[1]**POWER SMART** is the name used to encompass the Demand Side Management Programs being initiated by B.C.Hydro.

mining, chemical and pulp and paper customers that continue into the 1990's. Bill 59 'Economic Development Electricity Rate Program' amended Bill 28 and was introduced to allow for potential new economic activities that might be served with short term power, from various sources, which is surplus to B.C. Hydro's domestic requirements.

Critical Industries Act - Bill 31 (Rate 1846) was introduced to allow reopening or keeping open industries in B.C. through a package that included electricity rate discounts, taxation, labour cost and other concessions. The contracts were negotiated on an individual basis and for varying lengths of time. Contracts, which are primarily with metal mines, will extend sales through 1990/91. No contracts have been negotiated since 1987 and no additional ones will be.

Table 5.1
FIRM INDUSTRIAL MARKETING PROGRAMS

Fiscal Year	Block Recovery (Rate 1843) (GW.h)	Turbine Turndown (Rate 1844) (GW.h)	Industrial Rate Discount Act-Bill 28 (Rate 1845) (GW.h)	Critical Industries Act-Bill 31 (Rate 1846) (GW.h)	Total Industrial Marketing (GW.h)
1985/86 Actual	121	557	143	192	1,013
1986/87 Actual	0	639	335	591	1,565
1987/88 Actual	0	459	345	776	1,580
1988/89 Actual	0	0	546	772	1,318
FORECAST					
1989/90	-	-	1,085	465	1,550
1990/91	-	-	770	210	980
1991/92	-	-	640	-	640
1992/93	-	-	-	-	0
1993/94	-	-	-	-	0
1994/95 & on	-	-	-	-	-

5.2 INTERRUPTIBLE MARKETING PROGRAMS (E+)

The intent of the programs was to sell secondary energy at reduced rates for space heating and water heating purposes with the proviso that the service be interruptible. Secondary energy is defined as the energy normally available on an annual basis between critical and normal water years on B.C. Hydro's system. Customers will be interrupted when adequate secondary energy is not available or for certain peak demand critical situations. Recent agreements for improved operation of B.C. Hydro's system have meant less expected secondary energy and thus maximum sales under the E+ programs being substantially reduced. B.C. Hydro was subsequently given permission to close the rate in early 1990. Table 5.2 details the total load now expected and includes both new load expected plus existing load projected to transfer to the E+ rate.

Table 5.2
INTERRUPTIBLE MARKETING (E+) PROGRAMS

	<----- S A L E S (GW.h) -----> Residential	General	Totals	Losses (@ 15.8%) (GW.h)	Gross Reqt's (GW.h)	Peak (MW)
1985/86 Act.	-	-	-	-	-	-
1986/87 Act.	-	-	-	-	-	-
1987/88 Act.	(8)	(2)	(10)	-	-	-
1988/89 Act.	(53)	(23)	(76)	-	-	-
1989/90	155	90	245	39	284	93
1990/91	250	125	375	59	434	142
1991/92	250	125	375	59	434	142
1992/93	250	125	375	59	434	142
1993/94	250	125	375	59	434	142
1994/95	250	125	375	59	434	142
1995/96	250	125	375	59	434	142
1996/97	250	125	375	59	434	142
1997/98	250	125	375	59	434	142
1998/99	250	125	375	59	434	142
1999/00	250	125	375	59	434	142

Notes:
1. 1987/88 and 1988/89 actual sales (bracketed) are included in the integrated system actuals.
2. Forecast numbers include both load additions and load transfers from firm electric.
3. Peak demand (MW) is based on an annual load factor assumption of 35%.
4. No transmission Rate customer load is anticipated.

The **Residential Program** - (Rate Schedule 1105) involves the addition of electric heating (space or water) with maintenance of the present fuel-fired system as backup. Backup systems may be oil, propane, butane, wood or coal. In addition, existing electric heating systems may qualify for the rate with the addition of an appropriate backup system. This latter type load would have no peak impact on the B.C. Hydro system as it would be a transfer from firm to interruptible load.

The **General Program** - (Rate Schedules 1205, 1206 and 1207) is intended for commercial and industrial customers and is similar to the residential program. It is available for space heating, water heating, and industrial process heating where a permanent backup heating system is maintained which uses oil, propane or a solid fuel.

5.3 POWER SMART PROGRAMS

Power Smart is B.C. Hydro's name for demand side management programs. These programs refer to utility activities designed to reduce the utility's load. The reduction results from increased efficiency of energy use, on the part of the customer, that has been induced by the utility.

A major program was officially launched early in 1989. Present goals are for gross energy savings in the order of 2,700 GW.h by 1999/2000. These savings would be over and above the ongoing (price induced) conservation assumed to occur in the base forecast contained in this document.

Table 5.3 details the savings being assumed in studies for preparation of those areas of the 1990 distribution and transmission system plan utilizing only the probable energy forecast. Resource planning includes the contribution from Power Smart programs as a supply variable in the resource plan.

Table 5.3
POWER SMART (DEMAND SIDE MANAGEMENT) PROGRAMS

	Distribution Rate Customers							Transmission Rate Customers				TOTAL	
	RESID (GW.h)	COMM (GW.h)	INDUST. (GW.h)	Total (GW.h)	Losses (@ 15.8%) (GW.h)	Total Gross Savings (GW.h)	Peak Saving (59.4% L.F.) (MW)	Sales EE Motors (GW.h)	Losses (@ 8.3%) (GW.h)	Gross Savings (GW.h)	Peak Sav. (80 % LF) (MW)	Gross Savings (GW.h)	Peak Savings (MW)
1985/86 Act.	-	-	-	-	-	-	-	-	-	-	-	-	-
1986/87 Act.	-	-	-	-	-	-	-	-	-	-	-	-	-
1987/88 Act.	-	-	-	-	-	-	-	-	-	-	-	-	-
1988/89 Act.	-	-	-	-	-	-	-	-	-	-	-	-	-
1989/90	40	14	9	63	10	73	14	7	1	8	1	81	15
1990/91	98	134	50	282	45	327	63	42	3	45	6	372	69
1991/92	172	270	96	538	85	623	120	76	6	82	12	705	131
1992/93	242	449	148	839	133	972	187	129	11	140	20	1111	207
1993/94	307	627	191	1125	178	1303	250	184	15	199	28	1502	279
1994/95	354	787	226	1367	216	1583	304	234	19	253	36	1836	340
1995/96	383	903	268	1554	246	1800	346	292	24	316	45	2116	391
1996/97	408	933	307	1648	260	1908	367	350	29	379	54	2287	421
1997/98	434	967	342	1743	275	2018	388	400	33	433	62	2452	450
1998/99	464	956	375	1795	284	2079	399	442	37	479	68	2557	468
1999/2000	485	951	408	1844	291	2135	410	484	40	524	75	2660	485

APPENDIX A
FORECAST PROCESS AND METHODOLOGY

A.1 FORECAST PROCESS

The major inputs, steps and reviews/approval are shown chronologically in Figure A.1.

The source, usage and some brief comments on the major inputs follows:

1. B.C. Long Term Economic Growth Projection - Probable
   - prepared by Ministry of Finance and Corporate Relations (MF&CR);
   - 20-year projection of B.C. overall GDP, sectoral GDP and population are main contents used in the probable energy forecasts.

2. B.C. Long Term Economic Growth Projection - Low and High
   - prepared by Ministry of Finance and Corporate Relations (MF&CR);
   - alternate economic growth scenarios used in preparation of the uncertainty range in the energy forecasts.

3. Outlook for the B.C. Pulp and Paper Industries to the year 2010
   - prepared by Woodbridge, Reed and Associates;
   - used as basis for the longer term forecast for the paper and allied products manufacturing sector;
   - in general, longer term growth (beyond 15 years) is projected to be limited by the wood resource availability rather than markets.

4. Forecast of Electricity Consumption by the B.C. Mining Industry
   - prepared by H.N. Halvorson Consultants Ltd.;
   - used as basis for mining and smelting sector forecasts;
   - electric intensive mining industry in B.C. is seen to be limited by low long term outlook for copper prices and limited growth in world requirements for coking coal.

5. Background Paper: Electric Energy Requirements of the British Columbia Chemicals Industry
   - prepared by Canadian Resourcecon Limited;
   - used in preparation of the chemical and chemical products manufacturing sector forecast;
   - reviews current industry, the changes it is undergoing and looks at future prospects.

6. Survey of Electric Intensive Chemical Industry in B.C.
   - prepared by Powertech Labs, Inc.;
   - reviews the chemical industry associated with the pulp and paper sector and the potential impact on electricity use from the changes now going on.

7. Energy Demand in the B.C. Pulp and Paper Industry 1990-2010
   - prepared by Dr. Mark Jaccard and Frank Bohlken of Simon Fraser University;
   - run of Istum-PC pulp and paper model using inputs (production and energy prices) supplied by B.C. Hydro.

8. Update 1989, Outlook for Crude Oil and Natural Gas Prices, Review of Refinery Capacity Utilization in the Lower Mainland and Petrochemical Outlook
   - prepared by Confer Consulting Ltd.;
   - reviews oil and gas price outlook to year 2000, small (1 to 2 percent) annual real increases

may occur particularly towards end of period;
- discussion of Lower Mainland refining capacity;
- discussion of petrochemical industry potential for expansion in B.C.

9. Electricity Prices
   - based on pricing policies, real price declines of 1 to 2 percent per year seen through initial 10-year period.

10. Divisional Customer Forecasts
    - prepared by each of B.C. Hydro's four divisions;
    - short term (3-year) projections of residential and general customer additions;
    - form basis for total short term customer forecast and divisional energy forecast splits.

11. Conservation, Interruptible Marketing (E+) and Demand Side Management (DSM or Power Smart)
    - supplied by Energy Management, B.C.Hydro;
    - efficiency and usage improvements that would occur with no B.C. Hydro conservation programs are agreed on and included in the base forecast;
    - E+ and DSM (Power Smart) programs are not included in the base forecast.

12. Transmission Customer Plans - Short Term
    - supplied by Transmission Customer Services, B.C.Hydro on individual customer basis;
    - used as basis for most sectors of short term industrial forecast as 80% of industrial sales are to these large customers (approximately 80 in total).

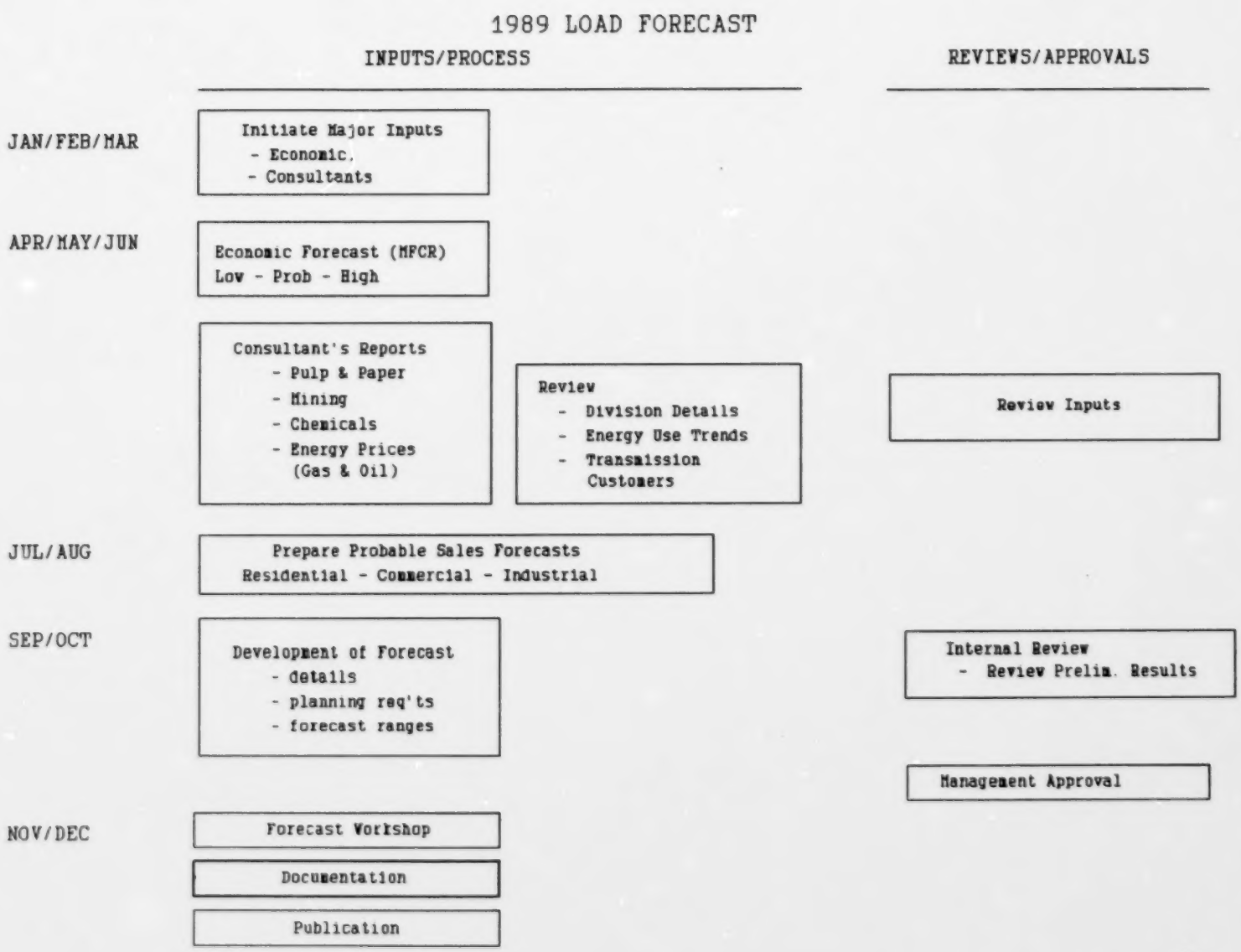


Figure A.1: 1989 Load Forecast Process

A.2 METHODOLOGY

The population, economic, sectoral and energy price forecasts are translated into electricity requirements using a "top down/end use" approach to forecasting. The top down aspect of the approach entails the use of the population and economic forecasts and sectoral outlooks to project the household formation, commercial activity and industrial production that generate the need for electricity. The end use focus consists of analysis of how various customers presently use electricity and how consumption patterns are likely to change in the future.

The effects of energy price changes are examined by first establishing the scope customers have for changing electricity use by measures such as: installing more efficient appliances and higher levels of insulation, choosing an alternative source of energy for heating, switching to more efficient lighting, substituting other energy sources or modifying the way electricity is used in existing industrial processes, changing industrial processes, or self-generating electricity rather than purchasing.

Preparation of the probable energy forecast includes the development of short and long term sales, energy and peak requirements. Regional details by rate category are developed for 11 years and summary level projections are developed for 21 years for use in long range planning. Also monthly details for the next fiscal year are prepared for use in revenue projections. A 10-year revenue forecast is also prepared.

The forecast is developed by residential, commercial and industrial sectors which are allocated to rate categories later in the process. Details on development of the forecasts for these main sectors follow:

a) **Residential**

The residential forecast (see Figure A.2) is developed with the use of two models - the cohort survival model and the residential model. Starting with demographic projections of fertility, mortality and migration, an age specific population forecast, by operating division (region), is developed using the cohort model. The provincial level results are compared and made to conform with the Ministry of Finance and Corporate Relations (MF&CR) population projection. The detailed results become one input to the residential model.

The residential model is an end-use stock model. That is, it starts with an age specific regional population projection and through projections of headship rates and dwelling preferences, develops a regional housing stock for each year of the forecast. Based on a base year load profile for each dwelling type in each region, and projections of usage trends for space heating, water heating, lighting and ten major appliances, the model develops energy sales forecasts. Also included in the model are considerations of space heating fuel choices based on fuel prices, furnace efficiencies, and gas availability; demolitions, conversions, and retrofitting of housing stock; and penetrations and life cycles of various appliances.

Also, an elaborate procedure exists for developing projections of short-term (3-year) account additions from the operating personnel in the field. Starting at the District level, Residential heating and non-heating (plus General under 35 kW and General, 35 kW and over) category customers are summated to the Division level. These numbers are compared to the results based on the long-term methodology and via review meetings between Load Forecast and Divisional staff, short-term customer numbers are determined. The customer numbers become the basis for providing Divisional energy projections for distribution planning purposes.

The historical energy data that is essential to the forecast analysis is maintained by the Forecasting Department. It is used in part for the weather normalization procedure which provides adjusted use data for the base year load profile.

Presently being implemented is a new residential end-use model, REEPS. The requirement for a new model is two-fold. To facilitate development and handling of Power Smart programs, a model beyond the capabilities of our existing one is required by both Forecasting and Marketing. Also, price effects and their sensitivities cannot be readily addressed in our present model, they must be handled exogenously. Acquisition of an existing outside model was determined to be more cost and time effective than further (extensive) development of the existing model.

b) Commercial

The commercial forecast (see Figure A.3) is developed from an analysis of the five main components (by Standard Industrial Classification - SIC):

- Transportation, Communication & Utilities
- Wholesale & Retail Trade
- Finance, Insurance and Real Estate
- Community, Business & Personal Services
- Public Administration

For each component the relationship between electricity use, GDP and population were established based on historical data. These relationships were then combined with projections of energy use rate, population and GDP growth, conservation trends, technological improvement and changes in lifestyle to obtain a projection of electricity use.

The ICA (Industrial Consumption Analysis) System is essential to the load analysis in the commercial sector. B.C. Hydro customers are coded by SIC in the ICA system allowing load data to be analyzed and projected consistent with the categorization of the sectoral economic drivers.

COMMEND, the EPRI commercial end use model, was recently acquired. Implementation and data collection is now proceeding. The model will be used in preparation of future forecasts.

c) Industrial

The industrial forecast is based on detailed analysis of each sector (SIC). For the areas of greatest significance, forestry, mining and the chemical industry, world market perspectives as obtained from consultants, were used as the basis of the longer term forecast. Production levels are analyzed in relation to provincial sectoral GDP forecasts. Patterns in energy intensity are considered in relation to technological change. Specific customer information is obtained and utilized to mold the short-term projections relative to the macro industry outlook.

The forecast is prepared on a customer specific basis for the large transmission rate accounts. The ICA system is also essential to load analysis in the industrial sector.

Use of specific key sector end use models is being pursued. With support from B.C. Hydro, a pulp and paper sector model (one sector from ISTUM, a U.S. developed industrial process model) has been developed for B.C within the Natural Resource Management Program at Simon Fraser University. Development work by SFU is ongoing for other industrial sectors.

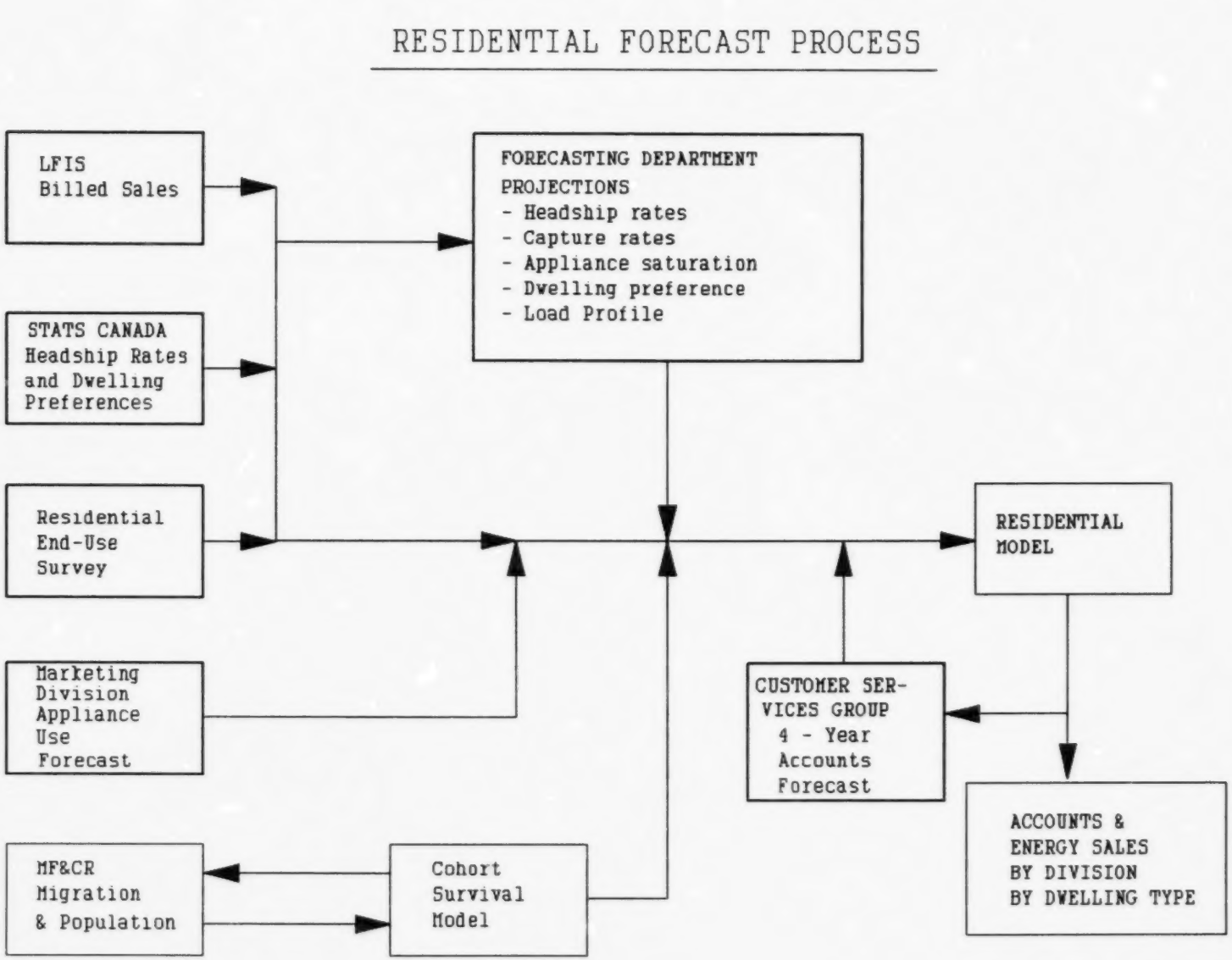


Figure A.2: Residential Forecast Process

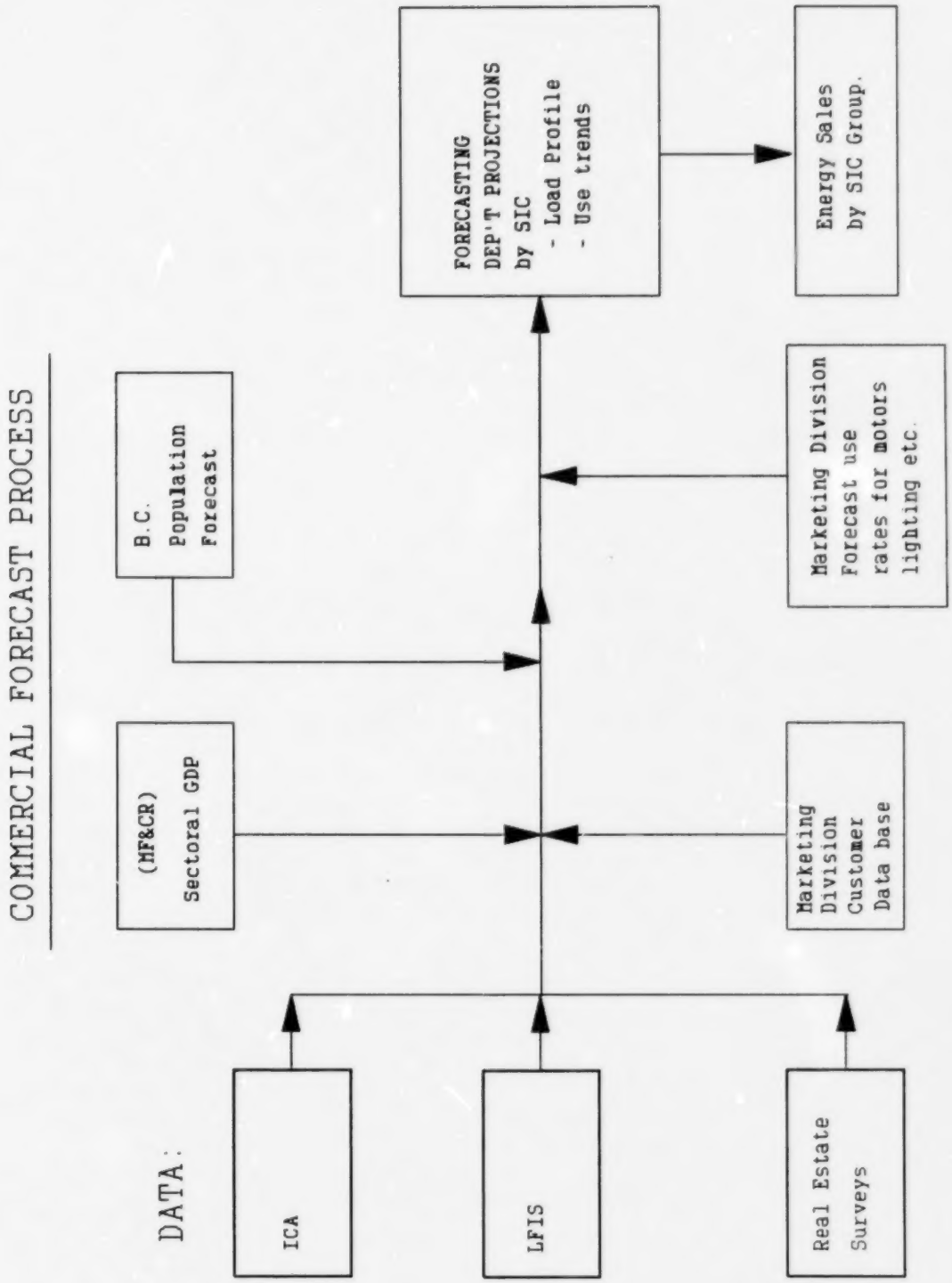


Figure A.3: Commercial Forecast Process

A.3 UNCERTAINTIES

The probability assessment for the probable economic forecast was developed and applied to the 1988 forecast. Essentially the same range has been assumed for this year's forecast. The 1988 assessment proceeded as follows:

- an uncertainty model employing Monte Carlo simulation methods was constructed to quantify and combine probability distributions on key variables;
- the model was structured in terms of three major sectors: industrial, residential, and commercial;
- each of the three major sectors was disaggregated into subsectors: under industrial there are six subsectors (pulp and paper, wood products, chemicals, coal mining, metal mining, and other), under residential, two subsectors (heating and non-heating); and under commercial, three subsectors (trade, service, and other);
- for each sector, one or two key variables were identified that have the largest effects on uncertainty over electrical sales in that sector. For example, the rate of new household formation has a major effect on the number of residential accounts, given a population forecast;
- a trained probability assessor worked with staff in B.C. Hydro's Forecasting group to subjectively assess conditional probability distributions over each of these key variables, assuming that the probable GDP forecast occurs;
- the uncertainty model was then used to combine these probability distributions and the other factors to develop probability distributions for sales in each sector, which were combined into an overall sales forecast distribution;
- the key assumptions for these assessments were that total GDP, population, and sectoral GDP are held constant at the probable forecast level;
- the probability distributions for variables in all sectors were assumed to be conditionally independent, in statistical terms.

The development of a probability distribution reflecting the three economic scenarios proceeded in the following manner:

- It was assumed that the extent of uncertainty associated with the high and low economic scenarios is the same as the uncertainty surrounding the probable scenario. That is, the distributions around the low and high scenarios have the same variance and skewness as the distribution around the probable, but they differ in their means and medians. This assumption was adopted to allow proceeding in a pragmatic manner and beginning to examine the overall distribution associated with all three economic scenarios, even though we have not conducted detailed subjective elicitations for the low and high cases.
- To construct one overall probability distribution reflecting the three scenarios, it was necessary to attach a probability to each scenario. A trained probability assessor worked with an expert in Central Statistics Bureau, Ministry of Finance and Corporate Relations (MF&CR) to quantify the probability of realization of the three different economic scenarios. In the judgement of MF&CR's expert, the likelihood of the actual GDP falling below the low scenario is 10% and the likelihood of actual GDP exceeding the high scenario is 15%.
- Given probabilities for each of the three scenarios and distributions around each of the scenarios, the overall probability distribution incorporating uncertainties associated with all three

scenarios was estimated.

- Sensitivity analysis was also conducted. A symmetric (25%) probability was placed on the low and high economic scenarios, and 50% on the probable economic scenario to construct an overall distribution, to see how sensitive the results were to MED's views on the likelihood of falling below the low scenario or exceeding the high scenario.

A.4 DETAILED INPUTS TO THE FORECAST

The following provides detail of the major inputs and sources of information that drive the forecasts:

a) **Residential**

- Migration and total population forecasts are obtained from Central Statistics Bureau (B.C.) in the Ministry of Finance and Corporate Relations (MF&CR).
- Historic fertility, mortality, migration, migrant age profile, and census population are obtained from Statistics Canada.
- Historic headship rates and dwelling preference are obtained from Statistics Canada.
- B.C. Hydro accounts by dwelling type and by region are obtained from the Customer Services Group.
- Demolition and conversion data come from the Commercial Activity Report (CAR) generated by Customer Services.
- Four-year account projections are developed in the field and cumulated by Forecasting.
- Historical account and total energy use information is obtained from the Load Forecast Information System (LFIS) - adjusted billing statistics.
- Degree day statistics are obtained from the Marketing Division.
- Base year load profiles are developed using the Residential End-Use Survey - 1988 for appliance saturations and Energy Management data sheets specifying estimated consumption rates for appliances.
- Projections of trends in energy consumption for appliances come from Residential Energy Management Department (part of Marketing).
- Comparative information on appliance saturations and use trends are obtained from other utilities through the Canadian Electrical Association (CEA) and the Electric Power Research Institute (EPRI) in the U.S.
- Space heating capture rates are available from Customer Services.
- Furnace efficiencies are determined from information from Residential Energy Management Department.
- Energy price projections are developed with assistance from consultants.

b) **Commercial**

- Sectoral GDP projections come from the Ministry of Finance and Corporate Relations (MF&CR).
- B.C. Population Forecast - from Ministry of Finance and Corporate Relations (MF&CR).
- Historical sales data is from LFIS and from the ICA System.
- Load profiles are developed from Commercial Energy Management data and from other utility data.
- Use patterns for various building types are obtained from a customer data base maintained by Commercial Energy Management.
- Forecast use trends are developed from specific application trends given by Commercial Energy Management.

c) **Industrial**

- Sectoral GDP projections come from Ministry of Finance and Corporate Relations (MF&CR).
- Key industry (electric intensive) world and provincial outlooks are obtained from consultants.
- Historic consumption data comes from LFIS/ICA and the Customer Information Control System (CICS).
- Short-term projections (1 to 5 years) are based on consultation with all major customers through the Transmission Customer Services Department.
- Energy use trends are obtained from recent studies, consultant inputs and historical trends.
- Reviews of the key sectors of the projections are solicited from provincial government agencies, consultants and other organizations.

APPENDIX B
RATE CATEGORIES

The forecast, as described in the body of this document, is developed along homogenous sectors, i.e. residential, commercial and industrial. For certain planning functions and revenue projections, however, it is necessary to transcribe the probable (base) forecast into rate categories.

A discussion of the rate categories and how they are estimated follows:

Residential
This category equates directly to the residential sector forecast and thus requires no translation.

General, Under 35 kW
This category encompasses mainly small commercial customers, e.g. the "corner store", and thus is contained largely in the commercial sector forecast. Customers are related to total General and Residential customers. Usage rates are based on historical trends. Customers, usage rates and thus total sales are compared with the total General category (i.e. including General, 35 kW and Over).

General, 35 kW and Over
This category contains larger commercial and smaller industrial customers. The projections, for consistency, are done concurrently with the General, Under 35 kW category, for customers, usage rates and total sales. As well, plans for transfer of larger customers to the Transmission Rate category are considered.

Transmission Rate
Included here are customers that have a demand of 5 MW or larger. These customers (approximately 80 at the end of 1988/89) are the larger industrial accounts such as pulp and paper mills, mines and chemical plants. Also included are refineries, some of the larger wood manufacturing facilities and some of the larger commercial customers such as U.B.C., grain and other bulk loading terminals. Projections in the short term are based on customer inputs and in the longer term are related to industry outlooks and projections.

Irrigation, Street Lighting and B.C. Hydro Own Use
These are small specific rate categories that are assumed to all be within the commercial sector.

Firm Industrial (Domestic) Marketing Programs
These loads are within the industrial sector and are primarily dealt with on an individual customer basis.

Table B.1 provides historical data and the forecast through 1999/2000 by rate categories.

Table B.1
B.C. HYDRO HISTORICAL AND PROBABLE ELECTRIC SALES FORECAST BY RATE CATEGORIES
(Billed Sales, No Adjustment For Accrual)

Fiscal Year	Resident. (GW.h)	-- General -- Under 35 kW (GW.h)	-- General -- 35 kW & Over (GW.h)	Trans. Rate (GW.h)	Irrig-ation (GW.h)	Street Light. (GW.h)	BCH own Use (GW.h)	Firm Dom. Mktg. (c) (GW.h)	Firm Exp. + Inter-Util. (a) (GW.h)	Total Billed Sales (GW.h)
HISTORICAL										
1978/79	7,492	2,159	6,353	9,133	35	198	132		218	25,720
1979/80	7,727	2,213	6,736	9,217	50	206	142		227	26,518
1980/81	8,042	2,226	7,118	9,597	41	220	89		231	27,564
1981/82	8,640	2,328	7,378	9,339 (b)	41	224	98		260	28,308
1982/83	8,821	2,301	7,403	9,046	47	228	99		261	28,206
1983/84	9,005	2,251	7,578	9,074 (b)	49	226	85	190	262	28,720
1984/85	9,577	2,423	7,917	10,498	56	230	89	446	267	31,503
1985/86	9,793	2,494	8,343	10,650	68	238	89	1,013	452	33,140
1986/87	9,665	2,426	8,546	11,134	57	239	81	1,565	622	34,335
1987/88	9,902	2,590	8,927	11,994	76	241	79	1,580	680	36,068
1988/89	10,700	2,737	9,497	12,338	72	242	78	1,318	733	37,715
Avg. Annual Growth: % 10 years:										
78/79-88/89	3.6%	2.4%	4.1%	3.1%	7.5%	2.0%	-5.1%	-	12.9%	3.9%
FORECAST										
1989/90	10,959	2,810	9,800	12,925	74	246	80	1,550	869	39,313
1990/91	11,257	2,903	10,198	14,070	76	249	81	980	981	40,795
1991/92	11,555	2,995	10,588	15,165	78	253	83	640	1,059	42,416
1992/93	11,839	3,087	10,991	16,305	79	257	84	0	942	43,584
1993/94	12,113	3,172	11,369	16,880	81	261	86	0	968	44,930
1994/95	12,373	3,243	11,720	17,360	83	265	88	0	992	46,124
1995/96	12,630	3,332	12,119	17,970	86	269	90	0	1,008	47,504
1996/97	12,870	3,411	12,550	18,430	88	273	91	0	1,040	48,753
1997/98	13,113	3,457	12,846	18,840	90	277	93	0	1,069	49,785
1998/99	13,349	3,548	13,287	19,300	92	281	95	0	1,099	51,051
1999/00	13,588	3,643	13,728	19,645	94	285	97	0	1,132	52,212
Avg. Annual Growth: % 11 years:										
88/89-99/00	2.2%	2.6%	3.4%	4.3%	2.5%	1.5%	2.0%	-	4.0%	3.0%

(a) "Firm Export & Inter-Utility" column includes: New Westminster, Point Roberts, Hyder, Out of Province (Alberta), Seattle City Light and W.K.P.& L.
(b) Forest industry labour disruptions in 1981/82 and 1983/84 caused reductions in Transmission Rate sales.
(c) Firm Domestic Marketing Programs are detailed in Table 5-1.